D e e p   S p a c e   N e t w o r k

Near-Earth and Deep Space Mission Support Requirements

DSN No. **870-014, Rev. BB**
Issue Date April 1, 1998
JPL Doc. No. D-0787, Rev. BB

Jet Propulsion Laboratory
California Institute of Technology

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Deep Space Network

Near-Earth and Deep Space Mission Support Requirements

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Jet Propulsion Laboratory
California Institute of Technology

[Signature on file at DDG]
DSN Document Release

Contents

Contents (continued)

Contents (continued)

Contents (continued)

Introduction

1 Purpose and Scope

The purpose of this document is to provide the National Aeronautics and Space Administration (NASA) and Jet Propulsion Laboratory (JPL) management with a concise summary of information concerning the forecasting of the necessary support and requirements for missions described in this publication.

This document presents a brief description of various missions along with specific support requirements for each. The mission described herein are those listed in the mission set prepared by the Mark IVA DSN Operations Planning Group. (See fig. 1.) Figure 1 is presented here to provide the reader with a general overview of the mission support requirements.

2 Revision and Control

Revisions or changes to the information presented in this document may be initiated by all Deep Space Network (DSN) personnel. The initiator should submit a written request for change to the Plans and Commitments manager's office.

Revisions, changes, and additions to this document will be issued during the first month of a calendar quarter.

3 Organization of Document

3.1 General

This document describes each individual mission in a separate module. The modules appear in alphabetical order, as listed in the table of contents. Appendix C consists of a listing and description of various potential flight projects that are being investigated by JPL at the present time.

3.2 Abbreviations

Acronyms and abbreviations used in this document are normally defined at the first textual use of each term. Lists of used acronyms and abbreviations are provided in appendix A. Document 810-3, *TDA Standard Practice — Glossary of Deep Space Network Abbreviations and Acronyms* can also be used to reference these abbreviations and acronyms. Various terms and definitions are listed in appendix B and a list of facility identifiers are contained in appendix D.

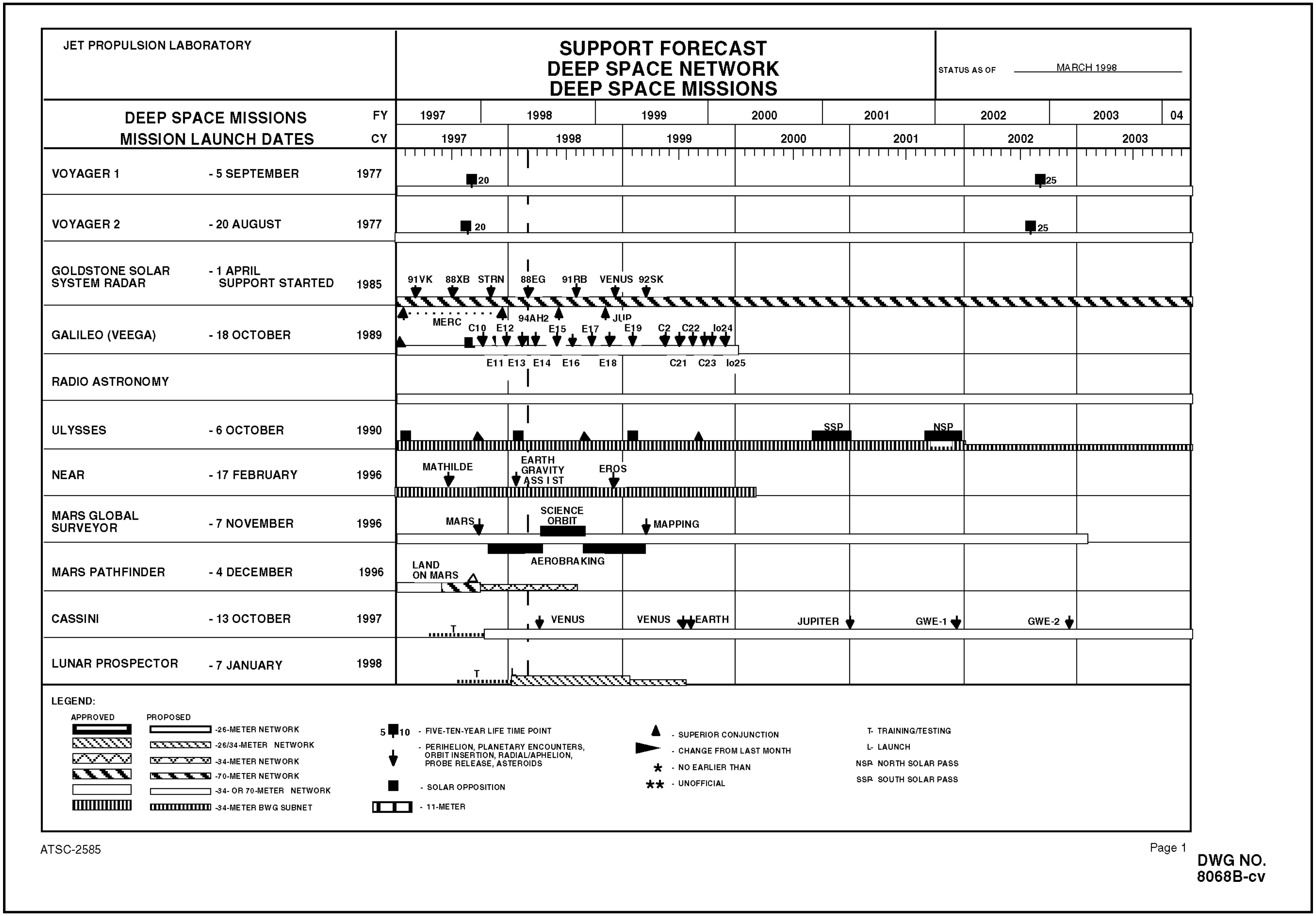


Figure 1. Mission Set

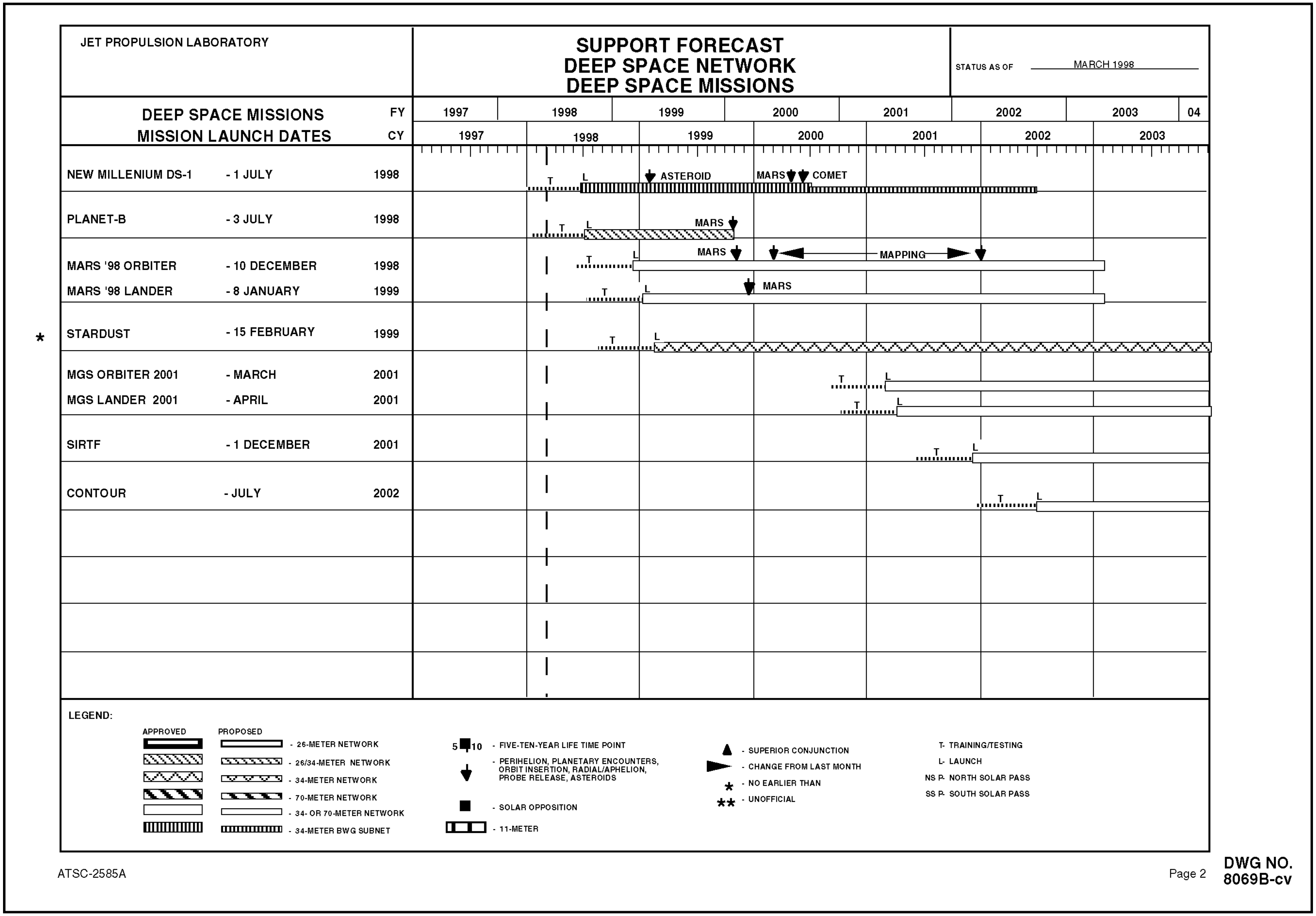


Figure 1.Mission Set (continued)

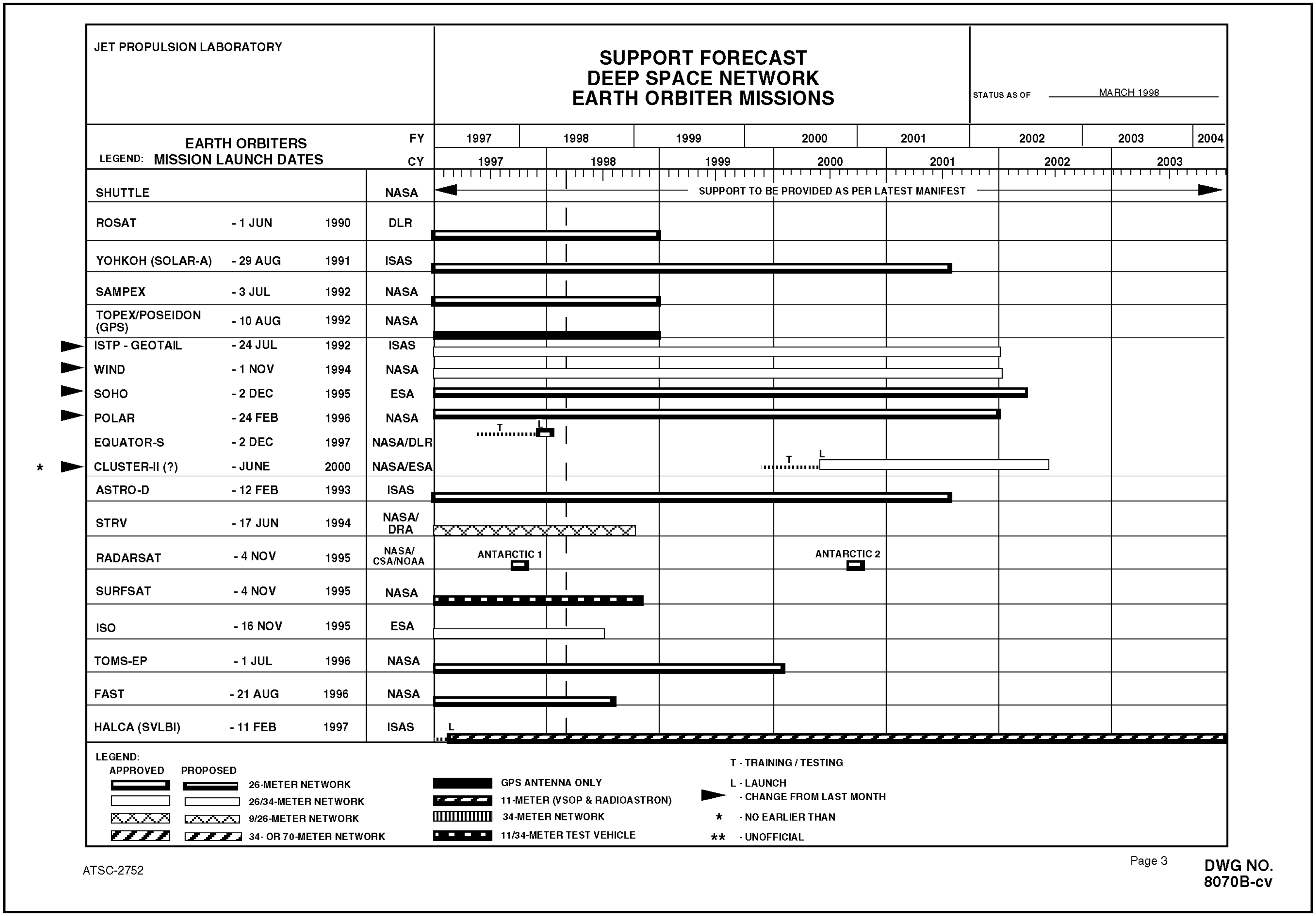


Figure 1.Mission Set (continued)

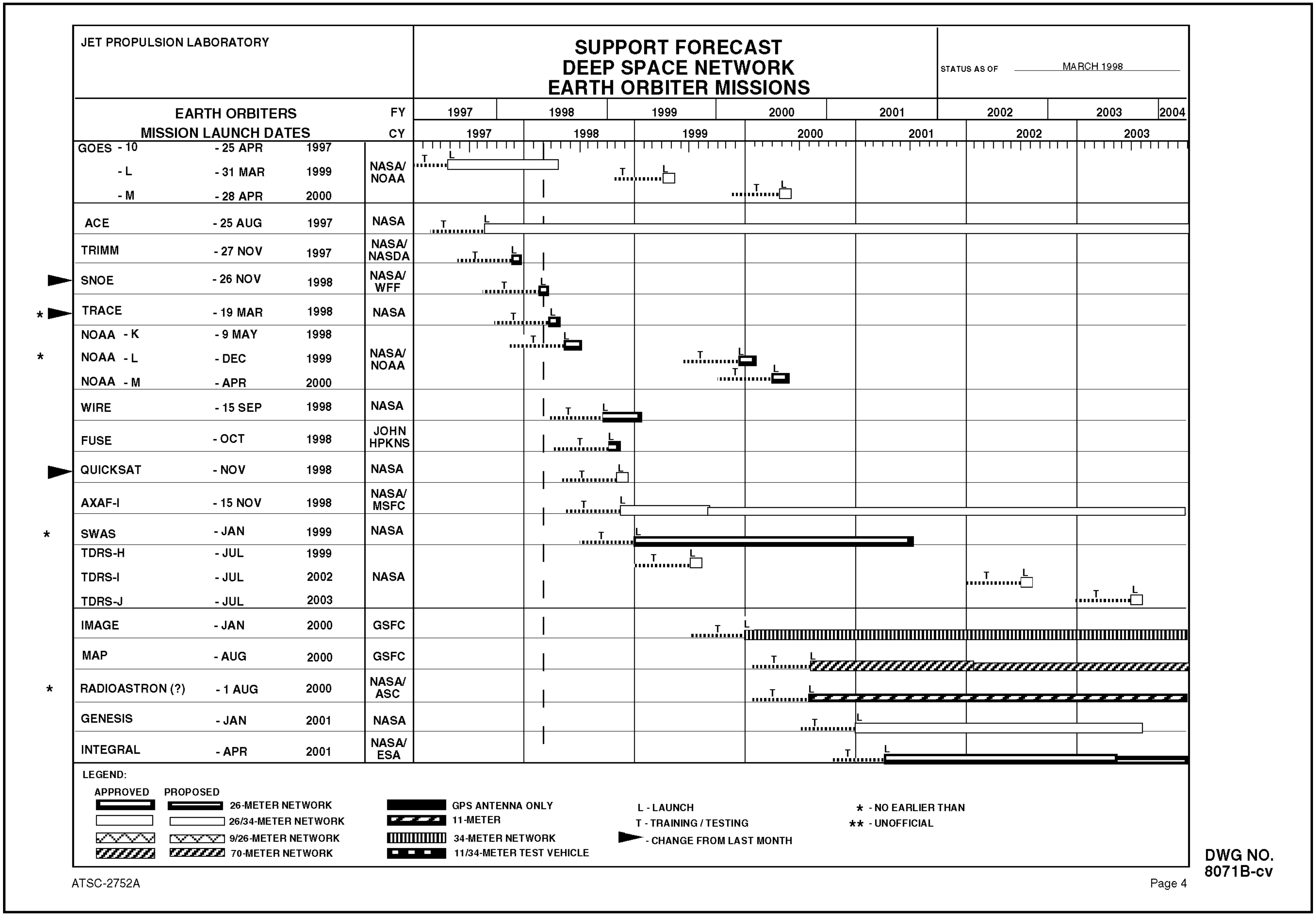


Figure 1.Mission Set (continued)

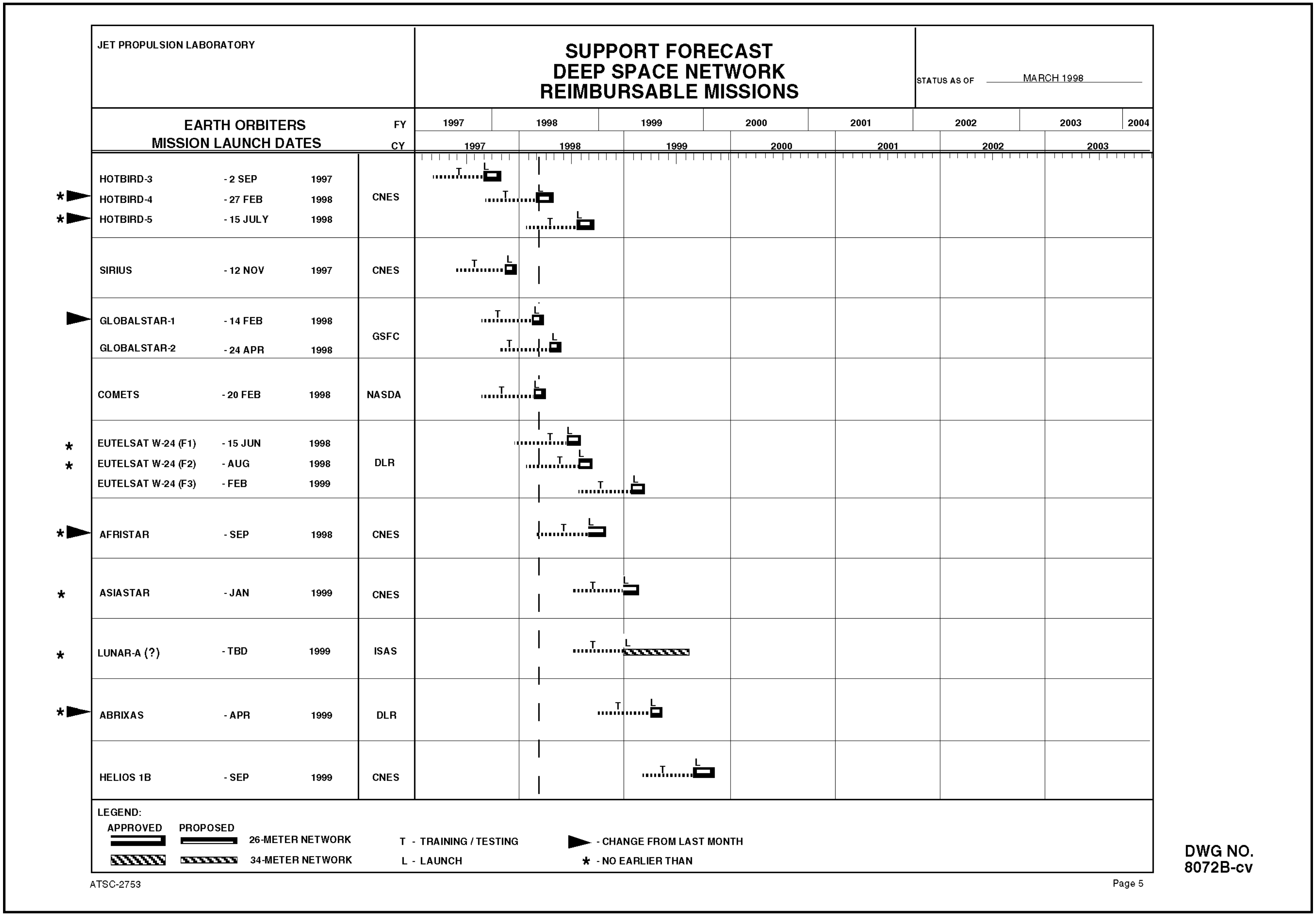
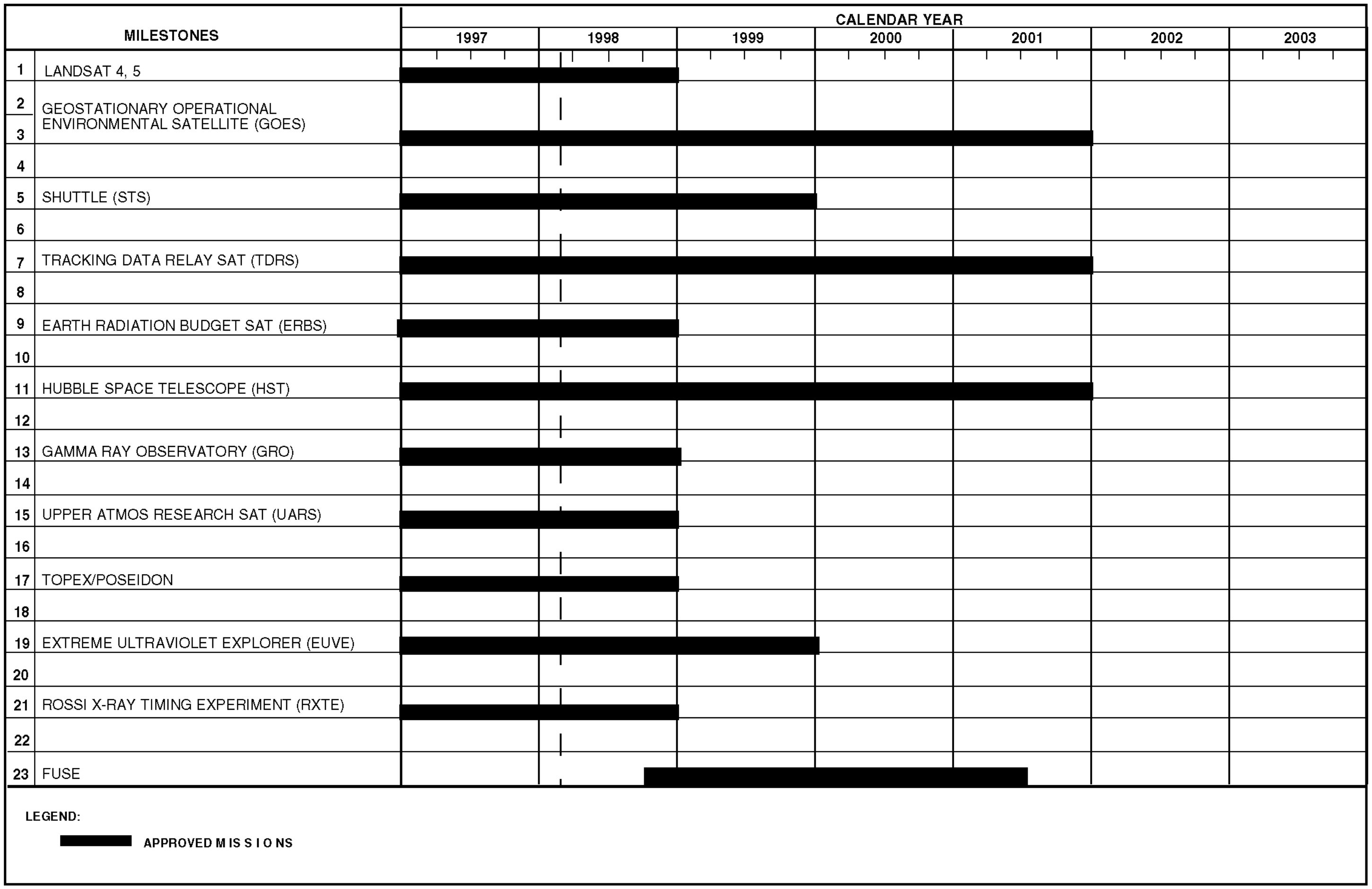


Figure 1.Mission Set (continued)

TELECOMMUNICATIONS AND MISSION OPERATIONS DIRECTORATE

JPL

DSN OPERATIONS
EMERGENCY SUPPORT MISSION SET



ATSC-973

Page 6

DWG NO.
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Figure 1.Mission Set (continued)

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Advanced Composition Explorer (ACE)

TMS Manager:	D.M. Enari	**Launch Vehicle:**	Delta II 7920
NOPE:	J.C. Green	**Range:**	ETR
Project Manager:	D. Margolies	**Launch Date:**	8/25/97
MOM:	F. Snow	**Projected Spacecraft Life:**	2 yr minimum
Project Responsibility:	GSFC	**DSN Support:**	5 yr goal

1 Mission Description

The objective of the ACE mission is to design, develop, launch, and successfully operate a spacecraft capable of meeting the scientific objectives of observing particles of solar, interplanetary, interstellar, and galactic origins, spanning the energy range from that of the solar wind (approximately 1 keV/nucleon) to galactic cosmic ray energies (several hundred MeV/nucleon). Studies will also be made of the abundance of essentially all isotopes from hydrogen to zinc, with exploratory isotope studies extending to zirconium. ACE will also monitor the solar wind and provide real-time data to scientists. Magnetic field, solar wind electrons, and solar flare electrons will also be measured.

2 Flight Profile

The ACE spacecraft is a class C observatory that was launched on August 25, 1997 into a modified halo orbit about Earth-Sun libration point L1, using a Delta II 7920 launch vehicle, from the Eastern range. This orbit will be a “broken Lissajous” approximation to a true halo orbit, with in-ecliptic and out-of-ecliptic amplitudes of about 300,000 km and 150,000 km, respectively. At the L1 distance, these will provide Sun-Earth-ACE angles of 10° and 5°, respectively. The period of this halo orbit will be about 178 d. ACE will reach the vicinity of L1 (1.5 million km from Earth along the Sun line) about 100 d after launch.

3 Coverage

3.1 Mission Phases

The DSN will support the cruise and orbital mission phases.

3.2 Coverage Goals

Coverage consists of the 26-m antenna subnet as prime and the 34-m antenna as backup. Initial acquisition will be at CDSCC. The required coverage for the mission duration is listed below:

Launch	10 continuous hours per day
Cruise (transfer)	One 4-hour pass per day
Orbit	One 3.5-hour pass per day

3.3 Network Support

The support provided by the DSN is indicated in the table below:

System (S-Band)	GDSCC					CDSCC				MDSCC			
	12	14	15	16	17	42	43	45	46	61	63	65	66
Telemetry	B			P		B			P	B			P
Command	B			P		B			P	B			P
Tracking	B			P		B			P	B			P
B = Backup, P = Prime													

4 Frequency Assignments

Frequencies are assigned according to the following:

System (S-band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2278.350	TBD
Command	2097.981	N/A	TBD
Tracking	2097.981	2278.350	TBD

5 Support Parameters

5.1 Telemetry

Data streams 1

Format TBD

Subcarrier frequency TBD

Bit rate 500 b/s, 8 kb/s, 88 kb/s

Recorded 88 kb/s

Coding Convolutional (K=TBD, R=1/2)

5.2 *Command*

Format	TBD
Bit rate	1000 b/s
Subcarrier:	
Frequency	16 kHz
Waveform	TBD

5.3 *Support*

Uplink power	TBD
Antenna:	
Rate	TBD
Angle data	TBD
Autotrack	TBD
Doppler rates	TBD
Range format	TBD
Recording	TBD

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	ETR/GSFC/DSN
Mission	DSN
Emergency	DSN

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Advanced X-Ray Astrophysics Facility-Imaging (AXAF-I)

TMS Manager:	E. Luers	**Launch Vehicle:**	STS
NOPE:	L. Weinberg	**Range:**	KSC
Project Manager:	F.S. Wojtalik	**Launch Date:**	11/15/98
GDSM:	D. Hood	**Projected Spacecraft Life:**	5 yr
Project Responsibility:	MSFC	**DSN Support:**	TBD
Sponsor:	NASA	**Source:**	MRR (Draft)

1 Mission Description

The Advanced X-Ray Astrophysics Facility (AXAF) is an imaging observatory spacecraft which performs X-ray astronomy research. The AXAF-I (Imaging) will contain four instruments: the high-resolution camera (HRC), the AXAF-I charge-coupled device (CCD) imaging spectrometer (ACIS), the high-energy transmission grating spectrometer (HETGS), and the low-energy transmission grating spectrometer (LETGS).

2 Flight Profile

The AXAF spacecraft will be launched from the Kennedy Space Center (KSC) on the space transportation system (STS) launch vehicle. The orbit characteristics will in an equatorial orbit with an inclination of 28.5°. The design reference orbit is a 30-d period during which the spacecraft is assumed to remain at an altitude of 10,000 by 140,000 km.

3 Coverage

3.1 Coverage Goals

The DSN will support the prelaunch compatibility test, data interface verification testing, and launch rehearsals. The DSN will support 3 45-min passes per day during routine mission operations.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC						CDSCC					MDSCC			
	12	**14**	**15**	**16**	**17**	**24**	**34**	**42**	**43**	**45**	**46**	**54**	**61**	**63**	**66**
Telemetry						P	P					P			
Command						P	P					P			
Tracking						P	P					P			
P = Prime															

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2250.0	RHC
Command	2071.875	N/A	RHC
Tracking	2071.875	2250.0	RHC

5 Support Parameters

5.1 Telemetry

Data streams	2
Format	PCM (NRZ-L)/PM/PCM (NRZ-L)/BPSK/PM
Subcarrier frequency	1.024 MHz (sine wave)
Bit rates:	
Subcarrier	8 or 32 kb/s
Carrier	64, 128, 256, 512, or 1024 kb/s
Coding	Convolutional (R=1/2, K=7) Reed-Solomon (255, 223) interleave depth of 5
Recording	Digital

5.2 Command

Format	PCM (NRZ-M)/PSK/PM
Subcarrier frequency	16 kHz
Bit rate	2 kb/s

5.3 Support

Uplink power	2 kW
Antenna:	
Rate	Low
Angle data	Required
Autotrack	Required
Doppler rates	Low
Range format	DSN standard
Recording	Digital

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	JSC
Early orbit	DSN
Mission	DSN
Emergency	DSN

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Afristar, Asiastar

TMS Manager:	P.T. Poon	**Launch Vehicle:**	Ariane
NOPE:	S. Waldherr	**Range:**	French Guyana
Project Manager:	J. Valencia	**Launch Date:**	Afristar:; NET 6/98 Asiastar: NET 12/98
MOM:	J.M. Soula	**Projected Spacecraft Life:**	12 yr
Project Responsibility:	CNES	**DSN Support:**	4 -14 s
Sponsor:	CNES	**Source:**	MRR (3/3/97)

1 Mission Description

The Worldstar satellite system is a radio broadcast satellite program named Worldspace, which covers the African-Arab and Asian region. The system consists of one to three satellites in orbit. Worldspace (a commercial entity) will employ radio broadcast digital direct technology worldwide by satellite to link emerging markets with information, education, and entertainment programming. ALCATEL Telecon of France is the satellite manufacturer.

2 Flight Profile

Afristar, Asiastar satellites will be launched from French Guyana on an Ariane 4 launch vehicle. The satellites will be placed in geostationary orbits over Africa and Asia

After separation of the satellite from the launch vehicle, telemetry, command, and ranging will be performed within S-band frequencies. After positioning of the satellite in its final orbit, CNES will activate the AM and FM downlink from three spot beams, each spot beam delivering 96 radio channels (AM) and 18 channels (FM).

3 Coverage

3.1 Launch and Early Orbit Phase

The DSN will support the launch and early orbit phase (LEOP).

3.2 Goals

CDSCC (26-m)) will provide launch and early orbit support on revolutions 1, 3, 5, and possibly 7 and 9. Telemetry, command, and tracking support will be provided.

3.3 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	CDSCC			
	42	43	45	46
Telemetry				P
Command				P
Tracking				P
P = Prime				

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2212.420	LCP/RCP
Command	2037.270	N/A	LCP/RCP
Tracking	2037.270	2212.420	LCP/RCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM(SP-L)/PSK/PM
Subcarrier frequency	32.768 kHz
Bit rates	1280 b/s
Coding	N/A)
Recording	Required

5.2 Command

Format	PCM (NRZ-L))/PSK/PM
Subcarrier frequency	8000 Hz
Bit rates	500 b/s

5.3 Support

Uplink power	1 to 2 kW
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes (26-m only)
Doppler rates	Modest
Range format:	
Prime	Tone (100-kHz major tone)
Recording:	
Analog	N/A
Digital	Required

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Ariane 4 launch	DSN/KER/AUS
Transfer/drift orbits	DSN/KRU/HBK/AUS/KER
Geostationary orbit	CNES

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Astro-D

TMS Manager:	A. Chang	**Launch Vehicle:**	N/A
NOPE:	S. Waldherr	**Range:**	N/A
Project Manager:	Y. Tanaka (ISAS) J. Hartman (GSFC)	**Launch Date:**	2/12/93
MOM:	K. Ninomiya (ISAS)	**Projected Spacecraft Life:**	4 yr
Project Responsibility:	ISAS	**DSN Support:**	2 yr prime, 2 yr extended
Sponsor:	ISAS	**Source:**	DMR for Astro-D

1 Mission Description

Astro-D is an X-ray astronomy satellite which was launched by an M3SII vehicle on 2/20/93. It is a scientific Earth-orbiting satellite of the Institute of Space and Astronautical Science (ISAS) of the ministry of education, science, and culture of Japan. After successful injection, the spacecraft, following custom, was renamed Advanced Satellite for Cosmology and Astrophysics (ASCA). Its mission is to provide powerful capabilities for the study of high-energy astrophysical phenomena.

2 Flight Profile

ASCA was launched on 2/20/93, from Kagoshima Space Center (KSC) in Uchinoura, Kagoshima Prefecture, Japan. ASCA was placed in a circular orbit with an inclination of 31° and an altitude of 550 km. The mission operations phase began on 3/24/93.

3 Coverage

No DSN launch support was required. The DSN began mission phase support on 3/24/93. Normally, DSN will be supporting only the bubble memory data recorder dump of 8.5 min at 262,144 b/s uncoded.

3.1 Coverage Goals

The DSN supports 4 contacts of 8 to 10 min each per day during the prime mission, with occasional high-activity periods requiring 6 to 8 contacts per day. Support consists of telemetry support only. Delivery of telemetry to ISAS will be within 48 h of data acquisition.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				P					P			P
Command	B			P		B			P	B		
Tracking	B			P		B			P	B		
P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2256.22	RCP
Command	N/A	N/A	N/A
Tracking	N/A	N/A	N/A

5 Support Parameters

5.1 Telemetry

Data stream	1
Format	PCM (NRZ-S) biphase-L/PM
Subcarrier frequency	
Bit rates	262144 b/s (playback)
Coding	N/A
Recording	Required

5.2 Command

Not required.

5.3 Support

Not required.

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Prelaunch	ISAS
Launch and LEOP	ISAS
Mission	DSN/ISAS

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Cassini

TMS Manager:	R. Gillette	**Launch Vehicle:**	N/A
NOPE:	L. Weinberg	**Range:**	N/A
Project Manager:	R. Spehalski	**Launch Date:**	10/15/97
Deputy Project Manager:	R. Draper	**Projected Spacecraft Life:**	10.7 yr
Project Responsibility:	JPL	**DSN Support:**	N/A
Sponsor:	NASA	**Source:**	MRR

1 Mission Description

Cassini is a deep space mission, launched on October 15, 1997. Cassini will arrive at Saturn in June 2004. After arrival at Saturn, Cassini will send a probe into the Titan atmosphere, then continue on a 4-yr satellite tour, using repeated gravity assists of Titan to shape the trajectory to satisfy science objectives.

The Cassini mission will accomplish a variety of science objectives during its exploration of the Saturnian system. Saturn's atmosphere, rings, satellites and magnetosphere are the prime areas of interest. The chemical composition, physical state, and dynamic behavior of the atmospheres of Titan and Saturn will be examined. The three-dimensional structure and dynamical behavior of the rings and the magnetosphere will be mapped, as well as the interactions between the satellites and the magnetosphere. The satellite investigations will study the atmosphere of Titan and its surface, and map the icy satellites.

2 Flight Profile

The Cassini mission to Saturn will cover a 10.7-yr period from 1997 to 2008. The spacecraft was launched from Cape Canaveral as a single payload using a Titan IV and Centaur upper stage as the launch vehicle. Cassini will use gravity assists with Venus, Earth, and Jupiter to provide the required energy to get to Saturn. The spacecraft will perform maneuvers and calibration activities during the interplanetary cruise, as well as limited science data collection.

Mission events are listed in the following table:

Event	Date
Launch	10/6/97
Venus Flyby	4/21/93, 6/20/99
Earth Flyby	8/16/99
Enter Asteroid Belt	12/12/99
Jupiter Flyby	12/30/00
Saturn Orbit Insertion	7/1/04
Probe Separation	11/6/04
Probe Entry	11/27/04
End of Mission	7/1/08

3 Coverage

3.1 Coverage Goals

The project requires one tracking pass per week from the 34-m HEF stations during cruise, and continuous 34-m HEF coverage around gravity assists and maneuvers. During Saturn orbital operations, one 34-m pass per day for the 23 d of cruise-like activities, and one 70-m pass per day during the 7 d of high-level activities for a typical 30-d orbit, are required. Periodic arraying of the 70-m and 34-m antennas will be required during Saturn orbital operations.

Cassini will use the spacecraft low-gain antenna (LGA) during most of the first 2 yr of cruise. While using the LGA, 70-m support will be required to support the low 20-b/s telemetry. During this time period, some simultaneous 34-/70-m coverage will be required to provide the uplink in order to meet the command and navigation requirements.

4 Frequency Assignments

Cassini will use X-band uplink and downlink for telemetry and radio metric support. Radio science experiments will be supported by a combination of X- and Ka-band uplinks and S-, X-, and Ka-band downlinks. Ka-band radio science support is required at DSS-25 by December 2001 to support the Cassini gravitational wave experiment (GWE).

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)
S-band:		
Radio science		2299.074074
Noncoherent		2298.333333
X-band:		
Command	7175.027006	
Telemetry		8429.938272
Tracking		8429.938272
Noncoherent		8427.222222
Ka-band:		
Radio science	34316.362434	32033.765432
Coherent (turnaround 14/15)		32028.604938
Noncoherent		32023.444444

5 Support Parameters

5.1 Telemetry

Radio frequency	X-band
Data rate (with Reed-Solomon)	20 b/s to 249 kb/s
Subcarrier frequency	22.5 kHz and 360 kHz (NRZ-L) or biphase-L data directly onto the carrier.
Coding	Convolutional (K=15, R=1/6) Reed-Solomon (J=8, E=16, I=5)

5.2 Command

Radio frequency	X-band
Data rate	7.8125 to 500 b/s
Subcarrier:	
Frequency	16 kHz
Waveform	Sine wave
Coding	PSK/NRZ-L
Power (emergency support)	20 kW on 70-m (January 2001)

5.3 Navigation

Doppler, ranging

5.4 Radio Science

Radio frequency	S-band, X-band, Ka-band
Open-loop (near real-time)	Required
Closed-loop (real-time)	Required

5.5 Monitor

Real-time station data	Required

5.6 Compatibility Tests

Compatibility testing was supported by DTF 21 and MIL 71.

Communications and Broadcasting Engineering Test Satellite (COMETS) (Reimbursable)

TMS Manager:	A. Chang	**Launch Vehicle:**	H-II
NOPE:	S. Waldherr	**Range:**	KSC
Project Manager:	K. Yoshimura (NASDA)	**Launch Date:**	2/20/98
MOM:	K. Ishihara (NASDA)	**Projected Spacecraft Life:**	3 yr
Project Responsibility:	NASDA, Japan	**DSN Support:**	1 mo
Sponsor:	NASDA	**Source:**	DMR (Draft 10/95)

1 Mission Description

The purpose of the COMETS mission is to develop new technologies in the fields of communication and broadcasting, such as interorbit communications, advanced satellite broadcasting, advanced mobile satellite communications, multifrequency band integration, and technologies to improve the performance of large geostationary satellites.

2 Flight Profile

COMETS was launched from the Yoshinobu Launch Complex of the Tanegashima Space Center (TSC), in southern Japan, by the H-II launch vehicle on February 20, 1998. The mission has been designed to follow the conventional injection sequence into geosynchronous orbit via parking orbit, transfer orbit, and drift orbit. Two firings of the apogee kick engine will be required to raise the perigee of the transfer orbit to the geosynchronous altitude. COMETS will be positioned at 121° East longitude.

3 Coverage

3.1 Coverage Goals

The DSN will support the launch and early orbit phase, from launch through 1 h after the final apogee engine firing, in real-time telemetry, ranging, Doppler tracking, and commanding. In contingency cases, the DSN will also be requested to support, in real time, telemetry, tracking, and commanding, through L+1 mo.

3.2 Network Support

DSN support will be provided as indicated in the following table:

System (S-Band)	GDSCC				CDSCC				MDSCC		
	14	15	16	24	42	43	34	46	61	63	66
Telemetry			P	B	B			P	B		P
Command			P	B	B			P	B		P
Tracking			P	B	B			P	B		P
B = Backup, P = Prime											

3.3 Prelaunch System Tests

Prelaunch system testing will be supported by the Development and Test Facility (DTF 21).

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2269.68	RCP
Command	2090.0	N/A	RCP
Tracking	2090.0	2278.68	RCP

5 Support Parameters

5.1 Telemetry

Data streams	2
Format	PCM (biphase-L)/PSK-PM
Subcarrier frequency	256 kHz
Bit rates	512, 2048 b/s
Coding	None
Recording	Required

5.2 Command

Format	PCM (NRZ-L)/PSK-PM
Bit rate	1000 b/s
Subcarrier:	
Frequency	16 kHz
Waveform	Sine wave

5.3 Support

Uplink power	1 to 10 kW
Antenna rate	Moderate
Antenna:	
Angle data	Required
Autotrack	Yes (26-m only)
Doppler rates	Moderate
Range format	Sine wave tone (100-kHz major tone)
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	TSC
LEOP	NASDA/NASA/JPL
Contingency	DSN (on request)
Geostationary orbit	NASDA

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Earth Radiation Budget Satellite (ERBS) *(Emergency Support)*

TMS Manager:	E. Luers	**Launch Vehicle:**	Delta
NOPE:	J.C. Green	**Range:**	WTR
Project Manager:	P. Pashby (GSFC)	**Launch Date:**	10/5/84
POD:	K. Hartnett (GSFC)	**Projected Spacecraft Life:**	Indefinite
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	NASA	**Source:**	SIRD (5/82)

1 Mission Description

The primary purpose of the ERBS project is to study the Earth's atmospheric processes and their relationship to the Earth's climate.

2 Flight Profile

The ERBS satellite was launched by the shuttle. Following deployment from the shuttle, a hydrazine propulsion system maneuvered the satellite into a circular orbit. The orbit parameters are 610 km x 610 km x 57°, with a period of 99.6 min.

3 Coverage

3.1 Coverage Goals

The DSN will support ERBS during emergency situations in the event the standard TDRSS to White Sands data link is inoperative. Emergency support will be provided by the DSN's 26-m antenna subnetwork.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				E	E				E			E
Command				E	E				E			E
Tracking				E	E				E			E
E = Emergency support												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2287.5	RCP
Command	2106.4	N/A	RCP
Tracking	2106.4	2287.5	RCP

5 Support Parameters

5.1 Telemetry

Data streams	2
Format	PCM (biphase-L)/PSK/PM
Subcarrier frequency	1024 MHz (sine wave)
Bit rates	1.0 kb/s, 1.6 kb/s, 12.8 kb/s, 32 kb/s, or 128 kb/s
Coding	None
Recording	Digital

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Subcarrier frequency	16 kHz (sine wave)
Bit rate	1 kb/s
Recording	Digital

5.3 Support

Uplink power	2 kW
Antenna:	
Rate	Moderate
Angle data	Moderate
Autotrack	Yes
Doppler rates	Moderate
Range format	Tone
Recording	Digital

Equator-S Contribution to the International Solar Terrestrial Physics (ISTP) Program

TMS Manager:	A. Chang	**Launch Vehicle:**	Ariane-IV
NOPE:	S. Waldherr	**Range:**	Kourou, FG
Project Manager:	P. Brittinger	**Launch Date:**	11/27/97
MOM:	T. Kuch	**Projected Spacecraft Life:**	2 yr
Project Responsibility:	Max Planck Institute	**DSN Support:**	28 d
Sponsor:	DLR	**Source:**	MRR (4/2/96)

1 Mission Description

The objectives of the Equator-S mission are to provide a high resolution plasma, magnetic, and electric field measurements in several regions not covered by any of the existing ISTP mission, namely the low-latitude day side magnetopause and its boundary layer, the equatorial ring current region, and the near-Earth equatorial plasma sheet. These regions play key role for our understanding of the global perspective of solar-terrestrial relations as well as the detailed plasmaphysical processes. To meet these objectives, the pay load will consist of a 3-axis flux-gate magnetometer, an electron drift instrument for the measurement of electric fields, 3-D spectrometer for electrons and ions, an ion composition instrument, high-energy particle detectors, and a potential control device.

2 Flight Profile

Equator-S will be launched on an Ariane-4 launch vehicle from Kourou in late 1997. The spacecraft will be injected into a standard GTO with a perigee height of 200 km, an apogee height of 35,750 km and an inclination of 7°. The final orbit will be achieved after a spin-up phase of several days by a single boost to 11 ranging equipment (geocentric) and perigee at 500 km altitude. The inclination will remain unchanged.

3 Coverage

3.1 Coverage Goals

To support the spacecraft activities during the launch and early orbit phase, a duration of 28 d, Tracking (angle data only), Telemetry and Command support from DSN are required. From separation until the first acquisition at the Weilheim station all DSN passes are needed. During the first 28 d, all DSN view periods have to be considered for support for a total amount of 4 h to 6 h of actual coverage time per day.

3.2 Network Support

DSN support will be provided as indicated in the following table:

System (S-Band)	GDSCC		CDSCC		MDSCC	
	16	24	42	46	61	66
Telemetry	P	B	B	P	B	P
Command	P	B	B	P	B	P
P = Prime, B = Backup						

3.3 Prelaunch System Tests

RF compatibility test will be conducted at DTF 21.

Interface verification tests and rehearsals will also be conducted prior to launch.

4 Frequency Assignments

Frequencies are allocated according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	2103.6	2284.5	RHC
Command	2103.6	2284.5	Linear/RCP (Depending on the antenna)

EUTELSAT-W24-F1, F2 and F3 (Reimbursable)

TMS Manager:	P.T. Poon	**Launch Vehicle:**	N/A
NOPE:	S. Waldherr	**Range:**	N/A
Project Manager:	P. Brittinger (GSOC)	**Launch Date:**	No earlier than 6/98; 8/98; 2/99
MOM:	N/A	**Projected Spacecraft Life:**	12 y
Project Responsibility:	GSOC	**DSN Support:**	6-14 d
Sponsor:	DLR/GSOC	**Source:**	DMR (Preliminary 8/96)

1 Mission Requirements

The EUTELSAT-W24-F1 mission will provide commercial telecommunications for the benefit of the European community. It will augment the aging EUTELSAT UU series satellite.

2 Flight Profile

The EUTELSAT-W24-F1 satellite will be launched from the Kennedy Space Center (KSC) on an Atlas IIA launch vehicle. The mission will follow the typical injection sequence: parking orbit, transfer orbit, and drift orbit. Apogee kick motor (AKM) firings will be performed to raise the spacecraft perigee. Drift phase orbital and attitude maneuvers will be performed to place the spacecraft in its final geostationary orbit.

3 Coverage

3.1 Coverage Goals

The coverage will be provided by the 26-m antenna at CDSCC for launch and critical support coverage during the transfer and drift orbits. Support will consist of a 9-h track on orbits 4, 6, and 8 with a backup strategy of up to 6 d in the event of AKM postponement.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC				CDSCC				MDSCC		
	12	14	16	17	42	43	45	46	61	63	66
Telemetry			P	B				P			P
Command			P	B				P			P
Tracking			P	B				P			P
P = Prime, B = Back up											

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2265.000	RCP/LCP
Command	2085.688	N/A	RCP/LCP
Tracking	2085.688	2265.000	RCP/LCP

5 Support Parameters

5.1 Telemetry

Date streams	1
Format	PCM (SP-L)/PSK/PM
Subcarrier frequency	32.768 kHz
Bit rates	4096 b/s (Conventional viterbi)
Coding	N/A
Recording	Required

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Subcarrier frequency	800 Hz
Bit rate	500 b/s

5.3 Support

Uplink power 1 to 2 kW

Antenna:
- Rate: Moderate
- Angle rate: Required
- Autotrack: Yes (26 m only)

Doppler rates Moderate

Range format:
- Prime: Tone (100-kHz major tone)
- Backup: DSN standard

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Atlas IIA launch	AUS/MAD/GDS/TBD
Transfer/drift orbits	AUS/MAD/GDS/TBD
Geostationary orbit	GSOC/EUTELSAT

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Extreme Ultraviolet Explorer (EUVE)
(Emergency Support)

TMS Manager:	E. Luers	**Launch Vehicle:**	Delta
NOPE:	J.C. Green	**Range:**	ETR
Project Manager:	P. Pashby (GSFC)	**Launch Date:**	5/28/92
Operations Director:	E. Macie (GSFC)	**Projected Spacecraft Life:**	Indefinite
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	NASA	**Source:**	SIRD

1 Mission Description

EUVE will conduct a survey of the entire celestial sphere in the extreme ultraviolet (UV) spectrum, 10 to 100 nm. This survey will be accomplished using four grazing incidence telescopes mounted on a spinning spacecraft whose spin axis is along the Sun line. The telescope's axes sweep out a circle perpendicular to the Sun line for each revolution of the spacecraft. The fourth telescope points in the antisolar direction. Data is taken only when the spacecraft is in the Earth’s shadow.

2 Flight Profile

The EUVE was placed into a near-circular orbit by a Delta expendable launch vehicle. The orbit is circular at an altitude of 550 km, with an inclination of 28.5° and a period of 96 min.

3 Coverage

3.1 Coverage Goals

Coverage will be provided by the DSN for EUVE emergencies that would prevent communications via the normal channels of the Tracking and Data Relay Satellite System (TDRSS). Emergency support will be provided by the 26-m subnet.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	**GDSCC**					**CDSCC**				**MDSCC**		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry				E	E				E			E
Command				E	E				E			E
Tracking				E	E				E			E
E = Emergency support												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2287.5	RCP
Command	2106.4	N/A	RCP
Tracking	2106.4	2287.5	RCP

5 Support Parameters

5.1 Telemetry

Data streams	2
Formats	PCM (biphase-S)/PM PCM (biphase-S)/PSK/PM
Subcarrier frequency	1.024 MHz (sine wave)
Bit rates	1.0 kb/s, 32 kb/s, 256 kb/s, 512 kb/s, 1024 kb/s
Coding	None
Recording	Digital

5.2 Command

Format	PCM (NRZ-M)/PSK/PM
Subcarrier frequency	16 kHz (sine wave)
Bit rate	2 kb/s
Recording	Digital

5.3 Support

Uplink power	Up to 2 kW
Antenna:	
Rate	High
Angle rate	Required
Autotrack	Yes
Doppler rates	Modest
Range format	Tone
Recording	Digital

Fast Auroral Snapshot Explorer (FAST)

TMS Manager:	E. Luers	**Launch Vehicle:**	Pegasus-XL
NOPE:	L. Weinberg	**Range:**	WR
Project Manager:	T. Gehringer (GSFC)	**Launch Date:**	8/21/96
DSOPM:	J. Catena (GSFC)	**Projected Spacecraft Life:**	1 yr
Project Responsibility:	GSFC	**DSN Support:**	1 yr
Sponsor:	NASA	**Source:**	SIRD (6/91)

1 Mission Description

FAST is the second explorer of the SMEX multimission program. Its primary objective is to investigate the plasma physics of the low-altitude auroral zone.

2 Flight Profile

FAST was launched on a Pegasus-XL small expendable launch vehicle from Vandenberg Air Force Base, Western range (WR). The spacecraft was launched into a nominal elliptical orbit of 350 km by 4200 km, with an inclination of 83°.

3 Coverage

3.1 Coverage Goals

The DSN will support 4 to 6 20-min contacts per day during the launch and early orbit phase. WFF and the DSN will be backup to Poker Flat and Kiruna, Sweden when apogee is over the northern hemisphere. WFF and the DSN (Canberra) are prime when apogee is over the Southern hemisphere.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				P	B				P			P
Command				P	B				P			P
Tracking				P	B				P			P
B = Backup, P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2215.00	LHC
Command	2039.65	N/A	LHC
Tracking	2039.65	2215.00	LHC

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM (NRZ-L)/PM
Subcarrier	None
Bit rates	4 kb/s, 900 kb/s
Coding	Convolutional (K=7, R=1/2)
CCSDS	Virtual channels (VC) 4 kb/s, provided asynchronously in real time; 900 kb/s (VCs 0, 1, 3, and 5), provided synchronously in real time; composite 900 kb/s, provided asynchronously during playback
Recording	Digital

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Subcarrier frequency	16 kHz (sine wave)
Bit rate	2.0 kb/s
Recording	Digital

5.3 Support

Uplink power	2 kW nominal
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes
Doppler rates	Moderate
Range format	Tone
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	GSFC
Mission	DSN/WFF/Kiruna, Sweden, and Poker Flat, Alaska
Emergency	DSN/WFF

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Galileo Europa Mission

TMS Manager	P. Beyer	**Launch Vehicle:**	STS-IUS
NOPE:	B. Yetter	**Range:**	ETR
Project Manager	R. T. Mitchell	**Launch Date:**	10/18/89
MOM:	N/A	**Projected Spacecraft Life:**	10 yr
Project Responsibility:	JPL	**DSN Support:**	10 yr
Sponsor:	NASA	**Source:**	MRR (2/97) DMR TBD

1 Mission Description

The Galileo Europa Mission (GEM) is a highly focused follow on to Galileo's current jupiter system exploration and a precursor for future missions to Europa and Io. GEM will conduct a detailed study of Europa over 14 mos, then plunge repeatedly through the Io Plasma Torus to reach volcanic Io.

2 Flight Profile

The GEM has three phases:

(1) The Europa campaign, a one year intense study of Europa comprised of 8 consecutive close encounters, with extensive remote sensing and fields and particles science data gathering at each (except for one near solar conjunction).

(2) The Perijove reduction campaign, 4 Callisto encounters rapidly lower the orbit to Io.

(3) Io encounter, a close flyby of Io in October 1999 with the possibility of a second flyby 6 wks later if the spacecraft is still alive.

3 Coverage

3.1 Coverage Goals

The June 1997 estimate of the antenna coverage profile is provided in the following table:

Mission Phase	Date	Month	Antenna
E12 through EOM	12/97 to 12/99	60	70-m

3.2 Network Support

DSN support will be provided as indicated in the following table:

System (S-Band)	GDSCC				CDSCC				MDSCC	
	12	14	15	16	42	43	34	46	63	66
Telemetry		P				P			P	
Command		P				P			P	
Tracking		P				P			P	
P = Prime										

3.3 Prelaunch System Test

Prelaunch and system testing was supported by MIL 71.

4 Frequency Assignments

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)	Polarization
S-Band:[a]			
(1) Telemetry		2295.0/2296.5	Linear/RCP[c]
(2) Command			RCP[c]
(a) Prime	2114.7		
(b) Spare	2113.3	2296.5	Linear/RCP[c]
(3) Tracking	2114.7		
X-band:[b]			
(1) Telemetry		8415.0/8420.4	RCP
(2) Command	7166.9		RCP
(3) Tracking			
(a) Prime	7166.9	8420.4	RCP
(b) Spare	7162.3		

[a] S-band LGA=RCP
[b] X-band is not currently supportable
[c] S-band HGA = Linear

5 Tracking Support Responsibility

The DSN is assigned responsibilities for tracking support.

Gamma Ray Observatory (GRO) (Emergency Support)

TMS Manager:	E. Luers	**Launch Vehicle:**	STS
NOPE:	J.C. Green	**Range:**	ETR
Project Manager:	J. Madden (GSFC)	**Launch Date:**	11/1/90
MOM:	K. Schauer	**Projected Spacecraft Life:**	Indefinite
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	NASA	**Source:**	SIRD (1/83)

1 Mission Description

GRO is an Earth-orbiting satellite that studies sources of localized, galactic, and extra-galactic gamma rays.

2 Flight Profile

The GRO satellite was placed into a near-circular orbit by the STS shuttle. Orbit parameters are 350 km x 450 km x 28.5° with a period of 93 min.

3 Coverage

3.1 Coverage Goals

DSN coverage for the GRO will be provided during emergencies that would prevent communications via the normal TDRSS-White Sands link. Emergency support will be provided by the DSN's 26-m antenna subnetwork.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry				E	E				E			E
Command				E	E				E			E
Tracking				E	E				E			E
E = Emergency support												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2287.5	LCP
Command	2106.4	N/A	LCP
Tracking	2106.4	2287.5	LCP

5 Support Parameters

5.1 Telemetry

Data streams	2
Format	PCM (biphase-M)/PSK/PM PCM/PM
Subcarrier frequency	1.024 MHz (sine wave)
Bit rates	1 kb/s, 32 kb/s, or 512 kb/s
Coding	None
Recording	Digital

5.2 Command

Format	PCM(NRZ-M)/PSK/PM
Bit rate	125 b/s or 1 kb/s
Subcarrier frequency	16 kHz (sine wave)
Recording	Digital

5.3 Support

Uplink power	2 kW
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes
Doppler rates	Moderate
Range format	Tone
Recording	Digital

Geostationary Operational Environmental Satellite (GOES I-M) METSAT Project

TMS Manager:	E. Luers	**Launch Vehicle:**	Delta
NOPE:	J.C. Green	**Range:**	ER
Project Manager:	M. Davis (GSFC)	**Launch Date:**	I: 4/14/94; J: 5/26/95; 10: 4/25/97; L: 12/2001; M: 8/12/99
DSOPM:	B. Thoman (GSFC)	**Projected Spacecraft Life:**	5 yr
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	NASA	**Source:**	NSP (8/93)

1 Mission Description

The primary objective of the METSAT project is to provide a satellite system that meets the National Environmental Satellite Data and Information Service (NESDIS) requirements as specified by the National Oceanic and Atmospheric Administration (NOAA). For the GOES I-M spacecraft, these requirements include an imager and sounder system, a space environment monitoring (SEM) system, a data collection system, and a search and rescue (SAR) system. The SEM subsystems include a solar X-ray sensor (XRS), an energetic particle sensor (EPS), a high-energy proton and alpha detector (HEPAD), a magnetometer, and an X-ray imager (XRI). The GOES I-M spacecraft will be designed to meet specified performance requirements for a period of 5 yr.

The GOES I-M mission profiles are identical. The NASA phase extends from lift-off through completion of spacecraft checkout (approximately 30–45 d after launch). The GOES I-M spacecraft are launched using an expendable launch vehicle (ELV) from Kennedy Space Center (KSC). At completion of spacecraft checkout, operations are transferred to NOAA, which will operate the spacecraft for the remainder of the mission.

2 Flight Profile

The GOES I-M spacecraft has been designed to be launched using an ELV. Additionally, the spacecraft has been designed to be retrieved by the shuttle in the event of a perigee kick motor (PKM) or similar failure that would prevent the spacecraft from leaving low Earth orbit.

During the launch vehicle ascent phase, spacecraft telemetry is relayed to the Suitland POCC using the STDN stations at MILA and Bermuda. After Atlas/Centaur separation, the Centaur upper stage performs two main engine burns to place the satellite into an elliptical orbit with the apogee close to geosynchronous altitude. Prior to satellite separation, the Centaur upper stage performs a reorientation maneuver to ensure that the GOES omni antenna rotation is normal to the plane of the Earth to eliminate look-angle nulls.

GDSCC, CDSCC, and MDSCC are used for telemetry, tracking, and command (TT&C) operations. The DSN is supplemented by telemetry and commanding capability from the NOAA Wallops CDA station.

3 Coverage

3.1 Coverage Goals

The coverage required for launch and the support of transfer and drift orbits will consist of the 26-m antenna as prime and the 34-m STD antenna as backup for 11 d at all complexes. There will also be contingency support for 15 d, for on-station spacecraft checkout. After the initial 30 to 45 d, the DSN is committed for emergency support. Emergency support will be provided by GDSCC only.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC							CDSCC				MDSCC			
	12	14	15	16	17	24	34	42	43	45	46	54	61	63	66
Telemetry	B			P	B	B	B	B			P	B	B		P
Command	B			P	B	B	B	B			P	B	B		P
Tracking	B			P	B	B	B	B			P	B	B		P
B = Backup, P = Prime															

NOTE

After checkout, all normal command and telemetry support is to be provided by NOAA (command and data acquisition) facilities at Wallops Island, VA. NASA emergency support following handover will be committed on a noninterference basis with ongoing NASA missions.

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2209.086/2208.586*	RCP
Command	2034.2	N/A	RCP
Tracking	2034.2	2209.086	RCP
* Dual carrier support required.			

5 Support Parameters

5.1 Telemetry

Data streams	2
Format	PCM (biphase-L)/PSK/PM
Subcarrier frequency	1.024 MHz (sine wave) (Subcarrier on each carrier)
Bit rate	2 kb/s
Recording	Digital

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Bit rate	250 b/s
Subcarrier frequency	16 kHz (sine wave)
Recording	Digital

5.3 Support

Uplink power	2 kW
Antenna:	
Rate	Nil, except for launch and transfer orbit
Angle data	Required
Autotrack	Yes
Doppler rates	Nil, except for launch and transfer orbit
Range format:	
Prime	Tone
Backup	DSN standard
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
ELV launch	STDN/KSC
Transfer/drift orbits	DSN
Geostationary orbit	NOAA/CDA
Emergency support	DSN

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Goldstone Solar System Radar (GSSR)

TMS Manager:	P.T. Poon	**Launch Vehicle:**	N/A
NOPE:	P. Wolken	**Range:**	N/A
Science Manager:	S. Ostro	**Launch Date:**	N/A
Friend of the Radar:	M. Slade III	**Operational Date:**	4/1/85
Project Manager:	M. Klein	**Projected Spacecraft Life:**	
Project Responsibility:	JPL	**DSN Support:**	Continuous
Sponsor:	NASA	**Source:**	SIRD (1/31/89); NSP (6/15/92)

1 Mission Description

The primary objective of the GDSCC solar system radar is the investigation of solar system bodies by means of Earth-based radar. Targets of primary interest include the Galilean moons, Saturn's rings and moons, and Earth-approaching asteroids and comets. Planets are also of interest, particularly Mercury and the planets to which NASA has not yet planned spacecraft visits.

2 Program Profile

Based on a history of solid achievement, including the definition of the astronomical unit, imaging and topography of Mars, Venus, and Mercury, and contributions to the general theory of relativity, the program will continue to support flight project requirements and its primary objectives. The individual target objectives are as follows:

Galilean: X-band observations will be used to put some limits on the moons: small-scale structure of the regolith.

Mercury: Construct radar maps of portions of the unimaged hemisphere at 10-km resolution. Make a series of closure-point ranging measurements to be used for testing gravitation theories, including general relativity. Some of this work is coordinated with Arecibo observations, as part of a cooperative effort to minimize systematic sources of error. Refine estimates of Mercury's pole direction, to evaluate available theoretical explanations for the planet's spin/orbit resonance.

Venus: Refine the rotation period and pole direction as much as possible prior to Magellan's orbital insertion. Obtain high-resolution (to Ý1 km) radar images of surface regions that cannot be mapped from Arecibo, at very small incidence angles 0 near 0, (i.e., with a viewing geometry very different from that 0 near 30° in Magellan images.) Locate geologically interesting regions as candidates for Magellan high-resolution investigation. Refine existing estimates of Fresnel reflection coefficients for surface units with anomalously high radar albedoes, and determine those regions’ angular backscattering law.

Moon: Construct 100-to-200-m-resolution images of selected regions in each component of the stokes vector, to elucidate the scattering mechanism and the nature of near-surface structure, and to constrain the electrical properties of the regolith. Measure topography in selected areas, to refine geologic interpretations of lunar landforms.

Mars: Maintain the accuracy of the Mars orbital ephemeris. Measure surface topography at tropical latitudes (±20°). Determine the surface reflectivity and effective slope for multiple ground tracks within the tropics. Use dual-polarization, cw measurements and joint Goldstone-VLA bistatic observations to elucidate the global variations in the surface's small-scale structural complexity. Constrain the surface's gross geometry at scales (Ý1 cm to Ý10 m) relevant to the safe landing and maneuverability of a spacecraft. Test hypotheses about temporal variations in radar reflectivity that might result from seasonal melting of subsurface ice.

Phobos and Deimos: Detect 3.5-cm radar echoes and estimate each satellite's radar albedo, polarization signature, and angular scattering law. Constrain the satellites' surface bulk density and small-scale roughness.

Near-Earth Asteroids: Secure recovery of newly discovered objects. Refine orbits of previously observed objects. Use delay/Doppler imaging to obtain information about dimensions, shapes, and spin vectors. Constrain surface's dual-polarization scattering properties and elucidate near-surface characteristics at cm-to-km structural scales. Measure the asteroid's radar cross section; estimate the radar albedo and use it to bound the regolith bulk density, porosity, and metal concentration.

Mainbelt Asteroids: Using time-delay measurements, shrink the line-of-sight component of positional error ellipsoid. Use power spectra to constrain pole direction and diameter. Estimate surface slope at topographic scales, and near-surface roughness at small scales. Measure the asteroid's radar cross section; estimate the radar albedo and use it to bound the regolith bulk density, porosity, and metal concentration.

Comets: Search for clouds of large (Š1 cm) particles near the nucleus, such as those discovered around Halley and IRAS-Araki-Alcock. Image the nucleus and determine its size, shape, spin properties, and surface characteristics. Refine estimates of orbital elements, to clarify the dynamical history of long-period comets and to assist spacecraft navigation during missions to short-period comets.

Europa, Ganymede, and Callisto: Determine the 3.5-cm radar albedo and circular polarization ratio of each of these icy satellites, whose 13-cm properties are extraordinary. Use the results to constrain existing theoretical explanations for the bizarre radar signatures. Search for radar features, localize them, and seek correlations with features in Voyager (and eventually Galileo) images. Refine the prediction ephemerides for each satellite, especially Callisto, to assist targeting of the Galileo spacecraft, by measuring echo Doppler frequencies. The precision of Doppler estimates depends on echo strength, and radar measurements with the minimum precision required for ephemeris improvement cannot be obtained during 1993–98 unless Goldstone has a 1.0-MW transmitter.

Io: Obtain the first 3.5-cm radar detection of this volcanically active satellite, and use estimates of radar properties to provide information about the surface bulk density and small-scale roughness.

Saturn's Rings: Use delay-Doppler images in each Stokes vector component to constrain the manner in which radar waves are backscattered from the classical ring sections, and to infer the physical properties of ring particles. Use bistatic observations, with Goldstone transmitting and the VLA receiving, to image the ring system at 1200-km resolution.

Saturn's Icy Satellites: Detect the first radar echoes from Iapetus and possibly Rhea, to ascertain whether these objects, whose surfaces contain nonwater ices, share the unusual radar properties of Jupiter's icy moons.

Titan: Detect radar echoes from Titan, and measure this object's radar albedo and angular scattering law. These measurements would constitute mankind's first direct measurements of Titan's surface. They would permit evaluation of the diverse models proposed for the configuration of Titan's surface, which might be at least partially covered by a deep, ethane-rich ocean.

3 Coverage

3.1 Coverage Goals

For this program, the coverage goals vary significantly with the target of opportunity. Listed in the table below are the goals that require the support of DSS 14, which is the only facility with the necessary high-power transmit capability. Support from DSS 12 and DSS 13 is occasionally needed.

The estimated program support for 1994-2004 is listed in the following table:

Targets	**Opportunities/ Year**	**Tracks/ Opportunity**	**Tracks/Year**
Mars	1/6 to 1/2	40	20
Venus	1/6 to 1	20	12
Jupiter	1	20	20
Saturn	1	30	30
Objects	6	7	42
Asteroids	4	5	20
Mercury	3	7	21
Moon	15	1	15
		Total tracks per year	180
		Average tracks per month	15

NOTE

One radar "track" consists of 8 h of observing time, preceded by 1.5 h of pre-cal and followed by 0.5 h of post-cal. Each track requires DSS 14. Interferometric observations (most Venus and selected Mercury tracks) also use DSS 13 and one other 34-m station.

The 10-yr period covered by these estimates will include planetary encounters and prolonged planetary operations by several major flight projects. For this reason, it is considered unlikely that the DSN could sustain the average level of radar support requested while meeting its commitments to in-flight projects. It is estimated that 50% of the requested support is a more realistic expectation on which the program should base its science planning.

3.2 Network Support

Specific requirements for antenna time on DSS 14 are prepared on a yearly basis and submitted to the scheduling office for negotiation at least 6 mo ahead of the earliest need date. The facility support to be provided by the DSN is indicated in the following table:

System	GDSCC Only	
	12	14
S-band (RAD)	P	
X-band (RAD)	P	
P = Prime		

NOTE

Antenna support requirements for 6 mo ahead are published in the GSSR bulletin board, which is updated on a weekly basis.

3.3 Compatibility Tests

Compatibility testing with DSN systems will be supported by the DSN radio astronomy unit. This data type is not required to be supported by the DSN ground data system (GDS).

4 Frequency Assignments

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)	Polarization
S-band	2320.00	2320.00	RCP
X-band	8510.00	8495.00	RCP

5 Support Parameters

5.1 Telemetry

Not required.

5.2 Command

Not required.

5.3 Support

Uplink power 500 kW

Antenna:
- Rate Planetary
- Angle data Required
- Autotrack Yes

Doppler rates Moderate

Range format None

Recording:
- Analog Not required
- Digital Not required
- VLBI Not required

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Program Phase	Support Responsibility
Implementation	DSN (331)
Planetary operations	DSN (940)

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Helios 1A and 1B (Reimbursable)

TMS Manager:	M. Wick	**Launch Vehicle:**	N/A
NOPE:	S. Waldherr	**Range:**	N/A
Project Manager:	L. Dulhern (CNES)	**Launch Date:**	7/7/95 and 9/99
MOM:	R. Simo-Pons (CNES)	**Projected Spacecraft Life:**	5 yr
Project Responsibility:	CNES	**DSN Support:**	20 d
Sponsor:	CNES	**Source:**	SIRD (1/93)

1 Mission Description

The Helios satellite's main objective is to provide the Italian, Spanish, and French defense systems with remote sensing data. The Helios system consists of two identical satellites, Helios 1A and 1B. Each satellite will have one high-resolution instrument and two tape recorders, which will be used to obtain constant and optimal illumination conditions.

2 Flight Profile

Helios will be launched from the Centre Spatial Guyanis in French Guiana on an Ariane-4 launch vehicle. The spacecraft will be injected into a near-circular polar orbit. Helios 1A and 1B will be in the same orbit, with a 180° separation.

3 Coverage

The Wallops and Fairbanks stations will be prime for Helios launch support.

3.1 Coverage Goals

GDSCC will be asked to provide telemetry, tracking, and command support on revolutions 2 and 3 only. DSS 16 will be prime with DSS 17 as backup if this occurs.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	**GDSCC**				
	12	**14**	**15**	**16**	**17**
Telemetry				P	B
Command				P	B
Tracking				P	B
B = Backup, P = Prime					

4 *Frequency Assignments*

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2200-2220 (TBD)	LCP/RCP
Command	2020-2040 (TBD)	N/A	LCP/RCP
Tracking	2020.2040	2200.2220	LCP/RCP

5 *Support Parameters*

5.1 *Telemetry*

Data streams	1
Format	PCM (SP-L)/PSK/PM
Subcarrier frequency	65.536 kHz
Bit rates	4096 b/s
Coding	N/A
Recording	Required

5.2 *Command*

Format	PCM (NRZ-L)/PSK/PM
Subcarrier frequency	8000 Hz (sine wave)
Bit rate	2000 b/s

5.3 *Support*

Uplink power	1 to 10 kW
Antenna:	
Rate	Moderate
Angle rate	Required
Autotrack	Yes (26-m antenna only)
Doppler rates	Modest
Range format:	
Prime	Tone (100-kHz major tone)
Backup	DSN standard
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table.

Mission Phase	Support Responsibility
Ariane-4 launch	WPS
Transfer/drift orbits	CNES/WPS/DSN
Geostationary orbit	CNES

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Hotbird-3, 4, and 5 (Reimbursable)

TMS Manager:	P.T. Poon	**Launch Vehicle:**	N/A
NOPE:	S. Waldherr	**Range:**	N/A
Project Manager:	J. Marechal	**Launch Date:**	Hotbird-3: 9/97; Hotbird-4: NET 2/98; Hotbird-5: NET 7/15/98
MOM:	J. Trebaol	**Projected Spacecraft Life:**	12 yr
Project Responsibility:	CNES	**DSN Support:**	4-14 d
Sponsor:	CNES	**Source:**	DMR (10/96)

1 Mission Description

The Hotbird satellite system is a broadcast satellite program of the European organization named EUTELSAT, which covers all Western Europe. The system consists of one to four satellites in orbit. Hotbird-2 was successfully launched in 11/96. Hotbird-3 was successfully launched on September 2, 1997.

EUTELSAT is a European telecommunication satellite organization created in 1977 by 17 member states of the European Conference of Postal and Telecommunications Administration (CEPT), which now is composed of 26 member states.

2 Flight Profile

Hotbird-4 will be launched from French Guiana on an Ariane 4 launch vehicle. The satellites will be placed in geostationary orbits over Europe.

After separation of the satellite from the launch vehicle, telemetry, command, and ranging will be performed within S-band frequencies. After positioning of the satellite in its final orbit, the Ku-band equipment will be activated.

3 Coverage

3.1 Launch and Early Orbit Phase

The DSN will support the launch and early orbit phase (LEOP).

3.2 Goals

Canberra (26-m) will provide launch and early orbit support on revolutions 1, 3, 5, and possibly 7 and 9. Telemetry, command, and tracking support will be provided.

3.3 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	CDSCC			
	42	43	45	46
Telemetry				P
Command				P
Tracking				P
P = Prime				

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2264.813	LCP/RCP
Command	2085.515	N/A	LCP/RCP
Tracking	2085.515	2264.813	LCP/RCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM (SP-L)/PSK/PM
Subcarrier frequency	32.768 kHz
Bit rates	512 b/s
Coding	N/A
Recording	Required

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Subcarrier frequency	8000 Hz
Bit rates	500 b/s

5.3 Support

Uplink power	1 to 2 kW
Antenna:	
Rate	Moderate
Angle rate	Required
Auto rate	Yes (26-m only)
Doppler rates	Modest
Range format:	
Prime	Tone (100-kHz major tone)
Recording:	
Analog	N/A
Digital	Required

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Ariane 4 launch	DSN/KER/AUS
Transfer/drift orbits	DSN/KRU/HBK/AUS/KER
Geostationary orbit	CNES

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Hubble Space Telescope (HST) (Emergency Support)

TMS Manager:	E. Luers	**Launch Vehicle:**	STS
NOPE:	J.C. Green	**Range:**	N/A
Project Manager:	J. Campbell (GSFC)	**Launch Date:**	4/24/90
MOM:	G. Repass (GSFC)	**Projected Spacecraft Life:**	15 yr
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	OSC	**Source:**	NSP (3/83)

1 Mission Description

HST is a national facility. It consists of a 2.4-m-aperture Ritchey-Chretien cassegrain telescope weighing approximately 9525 kg, with various energy detectors designed for the observation of IR, visible, and UV wavelengths (0.12 µm to 1.0 mm).

2 Flight Profile

The space telescope was deployed into a 28.5° inclination circular orbit, which permits a mission lifetime of 15 yr. Orbit: Decaying circular between 594 and 400 km x 28.5°; period = 95 min.

3 Coverage

3.1 Goals

The DSN is responsible for providing emergency support for the space telescope in the event a Tracking and Data Relay Satellite System (TDRSS) or spacecraft failure prevents communications via that link.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	**GDSCC**					**CDSCC**				**MDSCC**		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry				E	E				E			E
Command				E	E				E			E
Tracking				E	E				E			E
E = Emergency support												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2287.5	LCP
Command	2106.4063	N/A	LCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM (biphase-L)/PM
Subcarrier frequency	None
Bit rate	500 b/s, 4 kb/s, 32 kb/s, 1024 kb/s
Coding	None
Recording	Digital

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Bit rate	1 kb/s
Subcarrier frequency	16 kHz (sine wave)
Recording	Digital

5.3 Support

Uplink power	2 kW
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes
Doppler rates	Moderate
Range format	Tone
Recording	Digital

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Earth orbit	TDRSS
Emergency support	DSN

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Infrared Space Observatory (ISO) (Reciprocal)

TMS Manager:	D. Enari	**Launch Vehicle:**	Ariane
NOPE:	A. Knight	**Range:**	CSG
Project Manager:	J. Steinz (ESTEC)	**Launch Date:**	11/11/95
GSM:	A. Robson (ESOC)	**Projected Spacecraft Life:**	18-24 mo
Project Responsibility:	ESA	**DSN Support:**	2 yr
Sponsor:	NASA/ESA	**Source:**	MRR

1 Mission Description

The primary objectives of ISO is to provide spectroscopic, photometric, imaging, and polarimetric observations of selected celestial sources at infrared wavelengths from 2.3 sible sensitivity and spatial resolution. The ISO telescope contains four instruments to support the primary objectives, and the scientific life of the spacecraft is limited to the onboard cryogenic supply.

2 Flight Profile

ISO was launched on an Ariane 44P from Kourou, French Guiana, into a highly eccentric, near-geosynchronous orbit of 23.94 h at an inclination of 5.25°, with an apogee of 70,000 km and a perigee of 500 km, which is to occur at a longitude at the Western edge of the Pacific Ocean to allow for GDSCC support.

3 Coverage

The DSN support began after the launch and early orbit phase (LEOP) was completed, several days after launch. Spacecraft activation and checkout occurred during the first two weeks, followed by a performance verification during the next six weeks. The GDSCC 26-m and 34-m antennas provide support for real-time telemetry and command. ESA provides mission-dependent telemetry and command equipment for Goldstone to interface with the ISO Control Center at Villafranca, Spain. There is no on-board spacecraft storage for commands, and the mission is operated by a four-week preplanned detailed sequence.

3.1 Goals

The coverage will be provided by the 26-m and 34-m antennas at GDSCC. The ESA mission-dependent equipment will be located at SPC 10 for command telemetry support. There will be one track per day from 8 to 10 h, overlapping with the ESA Villafranca tracking station for incoming spacecraft transfer.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					
	12	14	15	16	17	27
Telemetry	B			B		P
Command	B			B		P
Tracking	B			B		P
B = Backup, P = Prime						

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2266.5000	RCP or LCP
Command	2087.06875	N/A	RCP or LCP
Tracking	2087.06875	2266.5000	RCP or LCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM-NRZ-L/PSK/PM
Subcarrier frequency	262.144 kHz
Bit rates	4096 b/s, 8192 b/s, 16384 b/s, 32768 b/s
Symbol rate/coding	8192 s/s, 16384 s/s, 32768 s/s, 65536 s/s
Record	N/A
Coding	Convolutional (K=7, R=1/2)

5.2 Command

Format	PCM-NRZ-L/PSK/PM
Bit rate	2000 b/s
Subcarrier:	
Frequency	8 kHz
Waveform	Sine

5.3 Support

Uplink power	200 W
Antenna:	
Rate	Sidereal
Angle data	Not required
Autotrack	Not required
Doppler rates	Moderate
Range format	None
Recording	N/A

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	ESA
Mission	ESA/NASA-DSN
Emergency	ESA/NASA-DSN

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International Solar Terrestrial Physics Program (ISTP) and Global Geospace Science (GGS) Initiative

TMS Manager:	A. Chang	**Launch Vehicle:**	Refer to the table below
NOPE:	S. Waldherr	**Range:**	Refer to the table below
Project Manager:	K. Sizemore (ISTP); J. Dezio (GGS)	**Launch Date:**	Refer to the table below
MOM:	D. Muhonen (GSFC) for SOHO; E. Macie (GSFC) for Geotail, Wind, Polar	**Projected Spacecraft Life:**	N/A
Project Responsibility:	GSFC (NASA/ISA/ ESA cooperative)	**DSN Support:**	N/A
Sponsor:	NASA/ISA/ESA	**Source:**	Geotail: SIRD (11/90); Wind/ Polar: SIRD (2/92); SOHO: DMR (7/93)

Mission	Agency	Launch Date	Launch Vehicle	Range
Geotail	ISAS	7/24/92	NASA medium ELV	ETR
Wind	NASA	11/1/94	NASA medium ELV	ETR
SOHO	ESA	12/2/95	NASA intermediate ELV	ETR
Polar	NASA	2/24/96	NASA medium ELV	WTR
Equator-S	NASA/DLK	11/27/97	Ariane IV	F.G.

1 Program Description

The ISTP is a multinational program involving three space agencies and six spacecraft. NASA, together with the Institute of Space and Astronautical Science (ISAS) and the European Space Agency (ESA), has agreed in principle to coordinate their efforts in investigating the Sun and the Earth. Each agency is planning to construct and operate different spacecraft as part of this cooperative venture. The following is a list of those agencies:

- Geotail, provided by ISAS
- Solar Heliospheric Observatory (SOHO), provided by ESA
- GGS Initiative, sponsored by NASA.

2 General Description

NASA contributions to the various ISTP missions are specified in two major initiatives:

- Collaborative Solar Terrestrial Research (COSTR)
- GGS

The COSTR Initiative will combine resources and scientific communities on an international scale to undertake the development of instruments and their appropriate support elements, along with ground-based theory investigations in the context of a comprehensive program of solar-terrestrial physics. This program will study the overall balance and nature of solar-terrestrial interaction of the GEOSPACE region. These joint NASA-ESA-ISAS missions will carry instruments operated by an international team of principal investigators. The missions will be launched by various launchers and supported by the international ground-based networks and systems.

Specifically, COSTR defines the NASA contribution in terms of instruments, launch vehicle, and launch tracking and operations support for the Geotail and SOHO missions.

The objective of the GGS Initiative is to undertake the development of two spacecraft and their appropriate support elements, and ground-based and theoretical investigations in the context of a comprehensive program of solar-terrestrial physics. This program in solar-terrestrial physics research will measure, model, and quantitatively assess the processes in the Sun-Earth interaction chain by the use of simultaneous spacecraft placed in complementary orbits.

Specifically, GGS defines the complete requirements which will be filled by the Wind and Polar missions.

The ESA contributions to the ISTP are defined in the ESA Solar Terrestrial Science Programme (STSP).

International Solar Terrestrial Physics (ISTP) Geotail Mission

TMS Manager:	A. Chang	**Launch Vehicle:**	Delta II
NOPE:	S. Waldherr	**Range:**	ETR
Project Manager:	K. Sizemore (GSFC)	**Launch Date:**	7/24/92
MOM:	E. Macie (GSFC)	**Projected Spacecraft Life:**	3 yr
Project Responsibility:	JPL Lead Network (ISAS cooperative)	**DSN Support:**	3 yr
Sponsor:	ISAS/NASA	**Source:**	SIRD (11/90)

1 General

The Geotail spacecraft was provided by ISAS and is a spin-stabilized cylindrical spacecraft 2.2 m in diameter and 2.3 m in height with a despun antenna. NASA provided a Delta launch vehicle, tracking support by the Deep Space Network (DSN), and data processing support by GSFC. In exchange, ISAS reserved part of the payload for NASA instruments together with a certain number of investigators from the United States.

As the solar wind flows toward the Earth, some of the energy is modified by the Earth's magnetosphere, ionosphere, and upper atmosphere. This interaction causes the flow to be altered, creating a plasmasphere, plasma sheet, and ring currents in the Earth's geomagnetic tail region. The result is a series of distinct regions which affect processes on the Earth. By traversing the tail region to a variety of depths, Geotail will be able to determine the size, position, and other properties of these regions. When correlated with information obtained from the other ISTP spacecraft, Geotail data should help to provide a more complete understanding of how the solar processes affect the Earth’s environment.

2 Flight Profile

The first launch of the COSTR Initiative was the ISAS spacecraft Geotail. Geotail was launched on 7/24/92. The primary mission will have a duration of 3 yr and an extended mission phase, lasting TBD. Two orbital phases are planned for Geotail.

In phase 1, the Moon’s gravity is used to control apogee, perigee, and orbital position in the magnetosphere by means of double lunar swingbys. Apogees will range from approximately 80 to 250 Re while perigees will vary between 5 and 10 Re. The orbital period during this phase will be 1- to 3-mo orbits, starting with the first lunar swingby 9/8/92.

In phase 2 Geotail will be moved to a lower geocentric orbit having dimensions of 8 x 30 Re. The orbital period during this phase will be approximately 4.9 d, starting in October 1994.

Orbits in both phase 1 and phase 2 will lie in or near the moon’s orbit plane.

3 Coverage

Primary ground station support will be from the USUDA 64-m station for 8 h/d, 5 d/wk (S-band and X-band).

DSN support will consist of receiving three or four tape recorder data transfers per day, over two or three DSN stations. Each transfer of data takes 2 h at 65 kb/s or 1 h at 131 kb/s (S-band only).

The bit rate will depend on the spacecraft range and whether support is from a 26-m or 34-m station.

The 26-m stations are baselined for Geotail support. However, portions of the mission will be supported by the 34-m STD stations.

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC				CDSCC				MDSCC		
	12	14	15	16	42	43	45	46	61	63	66
Telemetry	B			P	B			P	B		P
Tracking	B			P	B			P	B		P
B = Backup, P = Prime											

4 Frequency Assignments

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)
S-band	2081.0	2259.91
X-band	N/A	8474.66*
* Contingency telemetry support by 34-m S-band.		

5 Support Parameters

5.1 Telemetry

Real-time contingency PCM(NRZ-S) conv, biphase-L, PM

65.5 kb/s or 16.4 kb/s

Playback PCM(NRZ-S) conv, biphase-L, PM

131 kb/s or 65.5 kb/s

5.2 Command

Not required.

5.3 Ranging

DSN standard is not simultaneously with telemetry.

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Mission operations	DSN/ISAS

The Geotail spacecraft will be operated from the Geotail Project Operations Control Center (POCC) at ISAS. Command will be via Usuda.

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International Solar Terrestrial Physics (ISTP) Global Geospace Science (GGS) Initiative Polar Mission

TMS Manager:	A. Chang	**Launch Vehicle:**	N/A
NOPE:	S. Waldherr	**Range:**	N/A
Project Manager:	J. Dezio (GSFC)	**Launch Date:**	2/24/96
MOM:	E. Macie (NASDA)	**Projected Spacecraft Life:**	24 mo prime/1-yr extension
Project Responsibility:	GSFC	**DSN Support:**	3 yr
Sponsor:	NASA	**Source:**	SIRD (2/92)

1 Mission Description

The GGS polar spacecraft will be launched from WTR into a 2-Earth-radius by 9-Earth-radius polar orbit, with apogee near the North Pole.

2 Coverage

The DSN will provide all ISTP/GGS support as specified below.

The polar spacecraft will carry a NASA standard users transponder, and will communicate in S-band with the polar ground facilities via a spacecraft belt antenna and the DFSN S-band service. Four support intervals per day (approximately 45 min each in duration) will be required for receiving tape recorder playback data, and up to 12 h/d for the first month and 3.6 h/d thereafter will be needed for receiving real-time plasma wave instrument wideband data. Real-time telemetry for spacecraft and instrument performance monitoring will be received on a subcarrier simultaneously with either the tape recorder playback or wideband data on the main carrier. Spacecraft commanding is required throughout this period with ranging and range-rate support during all spacecraft contacts.

The 26-m subnet stations located at the DSN locations in Canberra, Goldstone, and Madrid are designated prime support stations. The 34-m STD support facilities can be used for support at the DSN's discretion provided they have a view period compatible with the required support.

3 Frequency Assignments

System (S-Band)	Uplink (MHz)	Downlink (MHz)
Telemetry	N/A	2265.0
Command	2085.688	N/A
Tracking	2085.688	2265.0

4 Support

4.1 Telemetry

Real-time	55.65 kb/s	PCM (NRZ-L) R-S, Convolutional, PSK, PM
Subcarrier	1.28-MHz sine wave	
Playback (tape recorder dump)	512 kb/s or 256 kb/s	PCM (NRZ-L), R-S, Convolutional, PM
PWI-WBD	256 kb/s	PCM (NRZ-L), R-S, Convolutional, PM

4.2 Command

Format	PCM/PSK/PM
Bit rate	1000 b/s
Subcarrier:	
Frequency	16 kHz
Waveform	Sine

4.3 Ranging

Sequential ranging assembly (SRA)

5 Support Parameters

5.1 Telemetry

Data streams	2
Format	PCM (biphase-L)/PSK/PM (all stations) FM/PM (MDSCC only)
Subcarrier frequency	48.25 kHz
Bit rates	250 b/s (all stations) IRIG 12, IRIG B (MDSCC only)
Coding	N/A
Recording	Required

5.2 Command

Format	PCM/FSK-AM/PM
Subcarrier frequency	8.6-kHz sine wave for (1) tone (With AM of 50% at 128 Hz) 7.4-kHz sine wave for (0) tone (With AM of 50% at 128 Hz)
Execute tone	5.79-kHz sine wave
Hold tone	7.4-kHz sine wave
Clock/data phase	90°
Bit rate	128 b/s

5.3 Support

Uplink power	1 to 10 kW
Antenna:	
Rate	Moderate
Angle rate	Required
Autotrack	Yes (26-m only)
Doppler rates	Modest
Range format	
Prime	Tone (100-kHz major tone)
Backup	DSN standard
Recording	Digital

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International Solar Terrestrial Physics (ISTP) Global Geospace Science (GGS) Initiative Wind Mission

TMS Manager:	A. Chang	**Launch Vehicle:**	Delta II
NOPE:	S. Waldherr	**Range:**	ETR
Project Manager:	J. Dezio (GSFC)	**Launch Date:**	11/1/94
MOM:	E. Macie (GSFC)	**Projected Spacecraft Life:**	24 mo prime/1-yr extension
Project Responsibility:	GSFC	**DSN Support:**	3 yr
Sponsor:	NASA	**Source:**	SIRD (2/92)

1 Mission Description

The launch of the Wind spacecraft placed the satellite into a Sun-side-apogee double lunar swing-by orbit for a period of 2 yr, after which Wind is to be transferred to a Sun-Earth L1 halo orbit.

2 Coverage

The Wind spacecraft carries a NASA standard users transponder and will normally communicate with the Wind ground facilities via a spacecraft medium-gain antenna (MGA) and the DSN S-band service. One 2.08-h support interval each 24-h spacecraft record cycle will be required for receiving tape recorder playback data. Real-time telemetry for spacecraft and instrument performance monitoring will be received on a subcarrier simultaneously with the tape recorder playback. Spacecraft commanding, ranging, and range rate are required throughout the spacecraft contact. The spacecraft requires that support periods be no more than 36 h apart during the prime mission.

The 26-m DSN stations at Canberra, Goldstone, and Madrid are designated prime support stations, with the 34-m standard subnet located at these facilities used for backup support, or when insufficient link margins exist in the mission orbit to acquire data at a BER of 10^{-5} or better with the 26-m station.

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC				CDSCC				MDSCC			
	12	14	15	16	42	43	45	46	61	63	65	66
Telemetry	B			P	B			P	B			P
Command	B			P	B			P	B			P
Tracking	B			P	B			P	B			P
B = Backup, P = Prime												

3 Frequency Assignments and Data Rates

System (S-Band)	Uplink (MHz)	Downlink (MHz)
Telemetry	N/A	2275.000
Command	2094.896	N/A
Tracking	2094.896	2275.000

4 Support Parameters

4.1 Telemetry

Real time	5.565 kb/s	PCM(NRZ-L), Reed-Solomon, convolutional, biphase-L, PSK, PM
	11.3 kb/s	2 x RT at < 60 Re
Subcarrier		1.28-MHz sine wave
Playback	64 kb/s or 32 kb/s	PCM(NRZ-L), Reed-Solomon, convolutional, biphase-L, PM
	128 kb/s	At < 60 caryn radii (Re)

4.2 Command

Format	PCM/PSK/PM
Bit rate	250 b/s
Subcarrier:	
Frequency	16 kHz
Waveform	Sine

4.3 Ranging

DSN standard.

International Solar Terrestrial Physics (ISTP) SOHO Mission

TMS Manager:	A. Chang	**Launch Vehicle:**	Atlas II
NOPE:	S. Waldherr	**Range:**	ETR
Project Manager:	K. Sizemore (GSFC)	**Launch Date:**	12/2/95
MOM:	D. Muhonen (GSFC)	**Projected Spacecraft Life:**	29 mo
Project Responsibility:	GSFC Lead Center (NASA/ESA cooperative)	**DSN Support:**	
Sponsor:	ESA/NASA	**Source:**	DMR

1 General

The Solar Heliospheric Observatory (SOHO) is a joint venture of NASA and ESA, and it is an element of both the ESA Terrestrial Science Programme (STSP) and the NASA ISTP program.

According to the NASA/ESA agreement formalized in the ESA/NASA Memorandum of Understanding and the STSP ESA/NASA Programme Plan, ESA procured the spacecraft in Europe, where it was to undergo its final integration and environmental testing, and NASA provided the launch vehicle, launch services, and the ground segment system to support all prelaunch activities and in-flight operations.

The scientific instruments aboard the spacecraft are provided by the principal investigators participating in the project.

In particular, the SOHO mission objectives are to study solar seismology and coronal dynamics, with emphasis on probing the interior structure of the Sun, characterizing strong and weak magnetic field regions in the chromosphere and corona, and investigating the outflow of plasma and the solar wind origin.

2 Flight Profile

SOHO will be placed in a halo orbit around the Sun-Earth L1 libration point, approximately 1.5 million km sunward from the Earth. The nominal mission duration is 2 yr and 5 mo. The launch and early orbit phase (LEOP) started at lift-off, included the coasting period in parking orbit, and ended with the injection of the spacecraft into the transfer trajectory. The transfer trajectory phase (TTP) started with the injection of the spacecraft into transfer orbit and ends with its injection into halo orbit. The Halo orbit phase (HOP) started at injection of the spacecraft into halo orbit on 3/7/96. For a period of 1 mo after insertion into halo orbit, the spacecraft and ground segment supported the commissioning of the service module (SVM) and of the instruments on board. The nominal routine operations begin after completion of the commissioning activities and last a minimum of 2 yr.

The spacecraft was launched by a NASA-provided Atlas II AS expendable launch vehicle (ELV) from the Eastern Space and Missile Center (ESMC). All subsequent mission operations are managed and implemented by NASA from NASA/GSFC and JPL facilities. ESA maintains overall responsibility for flight operations.

3 Coverage

3.1 Goals

The objective is to acquire all of the SOHO data through a combination of real-time and spacecraft data storage dumps. The 26-m subnetwork and the 34-m subnetwork provide support for SOHO operations. The required coverage is as follows:

10 mo/yr	One 8-h pass/d and 3 1.6-h passes/d
2 mo/yr that are selected by the DSN	Continuous coverage 24 h/d

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC						CDSCC				MDSCC			
	12	**14**	**15**	**16**	**17**	**27**	**42**	**43**	**45**	**46**	**61**	**63**	**65**	**66**
Telemetry	B			P		P	B			P	B			P
Command	B			P		P	B			P	B			P
Tracking	B			P		P	B			P	B			P
B = Backup, P = Prime														

4 Frequency Assignments

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2245.0	RCP
Command	2067.271	N/A	RCP
Tracking	2067.271	2245.0	RCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM/NRZ-L/R-S/CONV/biphase-L/PM (for MR and HR) PCM/NRZL/CONV/R-S/PSK/PM (for LR)
Subcarrier frequency	54.6 kHz, square wave
Bit rate	LR=1.2 kb/s, MR=47.4 kb/s, HR=211.2 kb/s

5.2 Command

Format	PCM/PSK/PM
Bit rate	2000 b/s
Subcarrier frequency	16 kHz, sine wave

5.3 Support

Uplink power	10 kW
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Required
Doppler rates	Moderate
Range format	SRA
Recording	Digital

6 Racking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
LEOP	DSN
Mission	DSN

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Landsat 4, 5
(Emergency Support)

TMS Manager:	E. Luers	**Launch Vehicle:**	N/A
NOPE:	J.C. Green	**Range:**	N/A
Project Manager:	TBD	**Launch Date:**	Landsat-4: 7/16/84; Landsat-5: 3/1/84
MSM:	M. Ambrose	**Projected Spacecraft Life:**	10 yr
Project Responsibility:	GSFC	**DSN Support:**	10 yr
Sponsor:	NASA	**Source:**	SIRD/NSP

1 Mission Description

The primary purpose of the Landsat satellites is to study Earth resources. The satellites contain a thematic mapper (TM) and a multispectral scanner (MSS) imaging device plus mission-unique hardware.

2 Flight Profile

Landsat-4 is currently in a circular Sun-synchronous orbit with orbital parameters of 699 km x 701 km x 98° inclination. The orbital period is 99 min.

Landsat-5 was launched into a nearly identical orbit with parameters of 705 km x 705 km x 98.2°.

3 Coverage

3.1 Coverage Goals

The DSN is responsible for providing emergency support for the Landsats in the event that a Tracking and Data Relay Satellite System (TDRSS) or spacecraft failure prevents communications via that link.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				E	E				E			E
Command				E	E				E			E
Tracking				E	E				E			E
E = Emergency support												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2287.5	See note
Command	2106.4063	N/A	See note
Tracking	2106.4063	2287.5	See note
NOTE: Landsat-4 polarization is RCP; Landsat-5 polarization is LCP.			

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM (biphase-S)/PSK/PM
Subcarrier frequency	1.024 MHz
Bit rates	1 kb/s, 8 kb/s, 256 kb/s

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Subcarrier frequency	16 kHz
Bit rate	2.0 kb/s

5.3 Support

Uplink power	16 W (nominal)
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes
Doppler rates	Moderate
Range format	Tone
Recording	Digital

Lunar Penetrator Mission (Lunar-A) (Reimbursable)

TMS Manager:	A. Chang	**Launch Vehicle:**	M-V
NOPE:	S. Waldherr	**Range:**	KSC, Japan
Project Manager:	M. Hinada (ISAS)	**Launch Date:**	TBD
MSM:	K. Ninomiya	**Projected Spacecraft Life:**	1 yr
Project Responsibility:	ISAS	**DSN Support:**	7 mo critical maneuvers
Sponsor:	ISAS	**Source:**	MMR (Draft 7/95); NOWG (12/95)

1 Mission Description

The Lunar-A mission includes a lunar polar orbiter, deployment of three penetrators to the lunar surface, and exploration of the lunar interior. The purpose of the Lunar-A mission is to study the internal structure as well as the surface of the Moon. The penetrators, two on the near side and one on the far side of the Moon, will carry seismometers and heat flow probes, allowing measurements of moonquakes, meteorite impacts, and heat flow from the interior. An expendable very-high-frequency antenna on each penetrator will send signals to the orbiter in lunar polar orbit, which will relay them back to Earth.

2 Flight Profile

Lunar-A is scheduled to be launched from the KSC in southern Japan by the M-V launch vehicle in August 1997. The translunar phase, which consists of four and one-half revolutions around the Earth, takes about 50 d. The spacecraft then makes its first lunar swingby to enlarge its orbit to one with an apogee of about 1,200,000 km. It then takes nearly 4 mo to make one further revolution around the Earth to reach the second swingby point, where it will be inserted into a 200-km-altitude circular lunar orbit. About a month will be required to deploy the three penetrators from a 45-km x 200-km slightly elliptical orbit. The interval between penetrator deployments is about 7 to 15 d. After all the penetrator modules are released, the orbital altitude of the bus spacecraft is controlled to 300 km in a circular orbit.

3 Coverage

3.1 Coverage Goals

The DSN will support all the critical maneuvers (such as delta vs., lunar swingby, lunar orbit insertion, and penetrator deployments) by performing orbit determinations from DSN tracking data and providing intercenter vectors to ISAS.

3.2 *Network Support*

DSN support will be provided as indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry												
Command												
Tracking				P	B					B		P
P = Prime, B = Backup												

4 *Frequency Assignments*

Frequencies are assigned according to the following table:

System (S-band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	N/A	N/A
Command	N/A	N/A	N/A
Tracking	2081.1	2259.91	RCP

5 *Support Parameters*

5.1 *Telemetry*

Not required.

5.2 *Command*

Not required.

5.3 Radiometric

Uplink power	1 to 10 kW
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes (26-m only)
Doppler rates	Moderate
Range format	Sine wave tone (100-kHz major tone)
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibility for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	KSC, NASDA
Before lunar swingby	UDSC, KSC, and DSN
Translunar	UDSC, KSC and DSN
Penetrator deployment	UDSC, KSC and DSN
Mission and data relay	UDSC and KSC

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Lunar Prospector

TMS Manager:	J.M. Stewart	**Launch Vehicle:**	LLV-2
NOPE:	A.B. Short	**Range:**	ETR
Project Manager:	A. Binder (LMA)	**Launch Date:**	1/7/98
MSM:	TBS	**Projected Spacecraft Life:**	2 yr
Project Responsibility:	LMA /ARC	**DSN Support:**	2 yr
Sponsor:	N/A	**Source:**	N/A

1 Mission Description

Lunar Prospector is the fourth of the NASA discovery missions. During a 1-yr polar orbiting mission, Lunar Prospector will map the moon's surface composition, gravity, magnetic fields, and volatile release activity. These data are needed for expanding on the lunar science legacy of Apollo and for planning future exploration missions. The relatively simple spin-stabilized spacecraft carries five remote-sensing instruments, and precision Doppler tracking data from the DSN will be utilized for the gravity field mapping experiment. An extended mission of 3 to 12 mo is contemplated to collect higher-resolution data at lower orbital altitudes, spacecraft health and propellant permitting. The project mission control center is in the Pioneer operations area at ARC.

2 Flight Profile

Lunar Prospector was launched at the Eastern test range (ETR) on January 7, 1998, on a Lockheed launch vehicle 2 (LLV-2). The flight to the Moon will take 5 d, during which two midcourse maneuvers occur, booms are deployed, and science instruments begin to collect calibration data. Once the spacecraft reaches the Moon, it will perform three separate Lunar Orbit Insertion burns. The first burn will put the spacecraft into a 24-h elliptical orbit. One day later, the second burn will put the spacecraft into a 4-h elliptical orbit. Finally, 24 h later, the third burn will insert the spacecraft into a circular, 118-min, 100-km-altitude polar mapping orbit. At that point the spacecraft will begin its nominal 1-yr mapping mission. During this phase, periodic orbital maintenance maneuvers will be made to keep the spacecraft in the proper orbit.

If, as expected, fuel is available at the end of the 1-yr nominal mission, the mapping may be extended, first during a 6-wk phase in a circular, 50-km-altitude orbit to obtain much more sensitive magnetic and gravity data, and then from elliptical orbits passing as low as 10 km above the surface over a a few areas of special interest. The mission will end when the fuel needed for orbital maintenance is depleted and the spacecraft crashes on the lunar surface.

3 Coverage

The Lunar Prospector mission requires extensive tracking coverage due to very limited data storage aboard the spacecraft. The nominal data return requirement is 85% of all available downlink telemetry data for the one-year primary mission. An options study conducted by a joint JPL/Wallops Flight Facility (WFF) team concluded that the most cost-effective means, with minimal impact on other network users, is to provide the tracking for Lunar Prospector by using a combination of the Transportable Orbital Tracking Station (TOTS) at Wallops, plus the DSN 26-m and 34-m S-band stations at Canberra and Madrid. GDSCC may also be scheduled for tracking when the WFF TOTS is unavailable. Only DSN stations will be used to provide the precision Doppler data for the gravity field mapping.

The support provided by the DSN and WFF is indicated in the following table:

System (S-Band)	GDSCC*					CDSCC				MDSCC			Wallops	
	12	14	15	16	17	42	43	45	46	61	63	66	TOTS	WOTS
Telemetry				P	B	B	B		P	B		P	P	B
Command				P	B	B	B		P	B		P	P	B
Tracking				P	B	B	B		P	B		P	P	B

P = Prime, B = Backup
* Gravity mapping tracks and backup for Wallops TOTS only.

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2273.000	RHCP
Command	2093.054	N/A	RHCP
Tracking	2093.054	2273.000	RHCP

5 Support Parameters

5.1 Telemetry

Data Streams	1
Format	NRZ-L/CONV/PSK/PM (CCSDS)
Subcarrier frequency	1.024 MHz
Bit rates	300 b/s (eng only) or 3600 b/s (sci + eng)
Recording	Not required
Coding	Convolutional (K=7, R=1/2)

5.2 Command

Format	PCM/PSK/PM
Bit rate	125 b/s
Subcarrier frequency	16 kHz

5.3 Support

Uplink power	TBS
Antenna:	
Rate	TBS
Angle data	TBS
Autotrack	TBS
Doppler rates	TBS
Range format	Sequential
Recording	Required

6 Tracking Support Responsibility

The assigned responsibility for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	ETR/DSN/WFF
Mission	DSN/WFF
Emergency	DSN/WFF

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Mars Global Surveyor

TMS Manager:	J.C. McKinney	**Launch Vehicle:**	Delta II
NOPE:	D. Recce	**Range:**	
Project Manager:	G. Cunningham	**Launch Date:**	11/7/96
MSM:	S. Dallas	**Projected Spacecraft Life:**	5 yr
Project Responsibility:	JPL	**DSN Support:**	5 yr
Sponsor:	NASA	**Source:**	MRR

1 Mission Description

The Mars Global Surveyor mission will deliver a single spacecraft to Mars for an extended orbital study of the surface, atmosphere, and gravitational and magnetic fields of the planet.

2 Flight Profile

The spacecraft was launched November 7, 1996. The best mass performance for the 1996 opportunity was obtained with a long interplanetary trajectory, with a transit time to Mars of approximately 10 mo. Insertion of the spacecraft into orbit at Mars will be accomplished utilizing the aerobraking technique. The mapping mission will be conducted from a mapping orbit that is nearly circular at low altitude (378 km) and Sun-synchronous at the desired solar orientation. Repetitive observations of the surface and atmosphere of the planet will be conducted throughout the primary mission, which extends for one martian year (687 d) from the start of the mapping phase, which began in February 1998.

3 Coverage

3.1 Coverage Goals

Coverage goals for the launch, cruise, orbit insertion, and mapping phases are listed in the following table:

Mission Phase	Period	Passes/ Month	Antenna
Launch (continuous coverage 30 d)	11/6/96-12/5/96	2/90	26-m, 34-m HEF
Cruise (except TCM-2 and TCM-3)	12/6/96-6/9/97	30	34-m HEF
TCM-2	2/27/97-2/2/97	90	34-m HEF
TCM-3	2/27/97-3/4/97	90	34-m HEF
Far cruise	6/10/97-8/9/97	60	34-m HEF
Mars approach	8/10/97-9/9/97	90	34-m HEF
Orbit insertion (aerobraking)	9/10/97-2/2/98	90	34-m HEF, 70-m (2 d at MOI)
Mapping	2/2/98-1/1/00	40	34-m HEF
Communications relay	1/1/00-1/1/03	30	34-m HEF

3.2 Network Support

The support provided by the DSN during the launch, cruise approach, mapping, and communications relay phases is indicated in the following table:

System (X-Band)	GDSCC			CDSCC			MDSCC		
	14	15	16	43	45	46	63	65	66
Telemetry		P			P			P	
Command		P			P			P	
Tracking		P			P	P*		P	
P = Prime (BWG may be used as a replacement during selected phases.) * 26-m X-band support for initial acquisition									

The support provided by the DSN during the MOI critical period and other declared critical periods is indicated in the following table:

System (X-Band)	GDSCC			CDSCC			MDSCC		
	14	15	16	43	45	46	63	65	66
Telemetry		P			P			P	
Telemetry (CP)	P	P		P	P		P	P	
Command		P			P			P	
Tracking		P			P	P		P	
P = Prime									

3.3 *Compatibility Tests*

Compatibility testing will be supported by DTF 21 and MIL 71. Prelaunch support will be provided by MIL 71, starting at L-5 mo.

4 *Frequency Assignments*

Frequencies assigned to the Mars Global Surveyor spacecraft are given in the following table:

System	Uplink (MHz)	Downlink (MHz)	Polarization
Command	7165.624229	N/A	RCP (LGA, HGA)
Telemetry transponder	N/A	8417.716050	RCP
Telemetry (USO)	N/A	8423.148147	RCP
Radiometric	7165.624	8417.716	RCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Modulation	PCM (NRZ-L)/PSK/PM
Subcarrier	320 kHz, 21.333 kHz
Science and engineering data plus Reed-Solomon encoding (sym/s)*	4 kb/s, 8 kb/s, 16 kb/s, 21.3334 kb/s, 32 kb/s, 40 kb/s, 42.6677 kb/s, 64 kb/s, 80 kb/s, 85.3334 kb/s
Engineering data (b/s)	10, 250, 2000, 8000, 16,000, 32,000
Coding	Convolutional (K = 7, R = 1/2)
Modulation index	Selectable

* Convolutional coding is also added, doubling the symbol rate transmitted to the ground.

5.2 Command

Modulation	PCM/PSK/PM
Subcarrier frequency	16 kHz
Bit rates	500 b/s, 250 b/s, 125 b/s (nominal), 62.5 b/s, 31.25 b/s, or 7.8125 b/s (emergency)

5.3 Support

DSN transmit power	20 kW HEF, 4 kW BWG
Angular rates	Planetary, except for initial near-Earth and early cruise
Radio science	Planetary occultations (687 d) and Mars gravity information from radiometric data.

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch (Delta II/PAM-D)	Launch vehicle
Injection	DSN
Cruise/planetary	DSN

Mars Pathfinder

TMS Manager:	D. Enari	**Launch Vehicle:**	Delta II
NOPE:	A.G. Knight	**Range:**	ETR
Project Manager:	A. Spear	**Launch Date:**	12/4/96
MOM:	B. Muirhead	**Projected Spacecraft Life:**	8 to 20 mo
Project Responsibility:	JPL	**DSN Support:**	8 to 20 mo
Sponsor:	NASA	**Source:**	MRR (1/3/94; reissued 11/94)

1 Mission Description

The Mars Pathfinder mission is a small low-cost discovery-class mission to Mars that was launched in December 1996. It placed a lander and rover on the surface in July 1997. It was configured as a single free-flyer spacecraft that entered the Mars atmosphere, descended, and semi-hard-landed on Mars. Surface operations provided data on the landing, the environment, and the rover deployment of technology experiments. The mission was considered a huge success and far exceeded the most optimistic expectations.

2 Flight Profile

The spacecraft was launched in December 1996 on a Delta launch vehicle, followed by an Earth-Mars transit time of 5 mo and a 1-mo Mars approach. Atmospheric entry and landing occurred approximately 6 mo after launch. Prime rover operations began immediately following landing and lasted for approximately 30 d.

3 Coverage

3.1 Coverage Goals

The DSN coverage consisted of 34-m HEF at X-band uplink and downlink frequencies from launch through end of mission and 70-m downlink support for the landing and 30-d primary surface mission. The coverage goals are listed in the following table:

Mission Phase	Period	Passes/ Month	Pass Duration (h)	Antenna Subnet
Near Earth	L+1 to L+30 (1 mo)	90	8	34-m HEF
Cruise	L+30 to M-1 (6-7 mo)	15	4 to 8	34-m HEF/BWG
Entry, descent, and landing	7/3/97	3	8 (continuous coverage)	34-m HEF/BWG
Landed operations	7/3/97 to 8/3/97	60	6	34-m HEF/70-m

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (X-Band)	GDSCC						CDSCC				MDSCC			
	12	14	15	16	17	24	42	43	45	46	61	63	65	66
Telemetry		P*	P					P*	P			P*	P	
Command		P*	P					P*	P			P*	P	
Tracking		P*	P					P*	P			P*	P	
P = Prime, B = Backup * Encounter/entry/descent/landing/emergency/surface operations.														

3.3 Compatibility Testing

TBD

4 Frequency Assignments

Frequencies are assigned according to the following table:

System X-Band	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	8427.222 8429.938	RCP RCP
Command	N/A	7175.027	RCP
Tracking	7175.027 7175.027	8427.222 8429.938	RCP RCP
NOTE: Only one telemetry radio frequency link at any given time.			

5 Support Parameters

5.1 Telemetry

Data Streams	1
Format	Biphase-L
Subcarrier frequencies	22.5, 360 kHz
Bit rates	5 b/s, 10 b/s, 20 b/s, 40 b/s, 150 b/s, 300 b/s, 395 b/s, 504 b/s, 600 b/s, 840 b/s, 1185 b/s, 1659 b/s, 1975 b/s, 2520 b/s, 3555 b/s, 4740 b/s, 6300 b/s, 8295 b/s, 11060 b/s

5.2 Command

Format	PCM/PSK/PM/NRZ-L
Bit rates	7.8125 b/s, 125 b/s, 250 b/s, 500 b/s
Subcarrier frequency	16 kHz

5.3 Support

Uplink power	20 kW nominal
Antenna:	
Rate	Moderate
Angle data	Not required
Doppler rates	Moderate
Range format	DSN standard

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	KSC/DSN
Cruise	DSN
Entry/descent/landing	DSN
Surface	DSN

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Mars Surveyor 1998 Program: Orbiter (MSO 1998) And Lander (MSL 1998)

TMS Manager:	J.C. McKinney	**Launch Vehicle:**	N/A
NOPE:	D. Recce	**Range:**	N/A
Project Manager:	J. McNamee	**Launch Date:**	Orbiter: 12/10/98; Lander: 1/8/99
MSM:	J. Beerer	**Projected Spacecraft Life:**	Orbiter: 4 yr, 2 mo; Lander: 1 yr, 2 mo
Project Responsibility:	JPL	**DSN Support:**	Orbiter: 4 yr, 2 mo; Lander: 1 yr, 2 mo
Sponsor:	NASA	**Source:**	MRR

1 Mission Description

Two spacecraft will be launched as the second step in the Mars Surveyor Program. One spacecraft will be an orbiter to continue the mapping of Mars, and the other spacecraft will be a Mars lander. These spacecraft will build on science from the Mars 1996 missions. They will help scientists trace the evolution of the climate of Mars and search for water in the soil of Mars.

2 Flight Profile

The two spacecraft will be launched in December 1998 (Orbiter) and January 1999 (Lander), using a Delta vehicle, from Cape Canaveral Air Force Station.

The Orbiter will arrive at Mars and perform Mars orbit insertion (MOI) no earlier than9/24/ 99. The aerobraking orbit insertion period will occur until about 12/3/99, when the Orbiter will start its mapping mission. The prime mapping phase will last until October 2001, and the Mars relay function will be used through December 2002 and may be extended to as late as February 2005.

The Lander will arrive at Mars and descend to the surface on 12/3/99. The primary Lander mission will last for 88 d, with the end of the prime mission planned for 2/29/00.

3 Coverage

3.1 Coverage Goals

Coverage goals for the launch, cruise, MOI, mapping, and relay only phases are provided in the following table:

Mission Phase	Period	Passes/ Month	Antennas	Comment
Orbiter				
Launch to L + 30 d	12/10/98-1/9/99	30	34-m HEF/BWG	4 h/d
L + 30 d to TCM-2	1/9/99-1/21/99	13	34-m HEF/BWG	4 h/d
TCM-2	1/21/99-1/28/99	30	34-m HEF/BWG	4 h/d
Cruise	1/28/99-7/23/99	13	34-m HEF/BWG	4 h/d
Mars approach (initial)	7/23/99-8/10/99	30	34-m HEF/BWG	4 h/d
Mars approach (final), MOI and aerobraking walk-in	8/10/99-9/27/99	90	34-m HEF/BWG	4 h/d
Aerobraking (main and walkout)	9/27/99-12/3/99	90	34-m HEF/BWG	8 h/d
Mapping	12/3/99-10/19/01	30	34-m HEF/BWG	10 h/d
Relay only	10/19/01-12/2/02	30	34-m HEF/BWG	10 h/d
Lander				
Launch to L + 30 d	1/3/99	30	34-m HEF/BWG	4 h/d
L + 30 d to TCM-2	2/2/99-2/14/99	13	34-m HEF/BWG	4 h/d
TCM-2	2/14/99-2/21/99	30	34-m HEF/BWG	4 h/d
Cruise	2/21/99-10/1/99	13	34-m HEF/BWG	4 h/d
Mars approach (initial)	10/1/99-10/19/99	30	34-m HEF/BWG	4 h/d
Mars approach (TCM-4, TCM-5, and entry)	10/19/99-12/3/99	90	34-m HEF/BWG	4 h/d
Prime mission	12/3/99	30	34-m HEF/BWG	10 h/d

3.2 Network Support

The support provided to the Orbiter and Lander by the DSN during all phases of the mission is indicated in the following table:

System (X-Band)	GDSCC			CDSCC			MDSCC		
	14	15	25	43	55	34	63	65	54
Telemetry	*	P	A	*	P	A	*	P	A
Command		P	A		P	A		P	A
Tracking		P	A		P	A		P	A

P = Prime, A = Alternate (Will be used as a replacement for the 34-m HEF during selected periods.)

* May be used during emergency or safe-mode spacecraft operation approaching maximum range. May be used for selected direct transmission from the Lander back to Earth.

3.3 Compatibility Tests

Compatibility testing will be supported by the Compatibility Test Trailer (CTT) for both the Orbiter and the Lander. Separate compatibility tests are planned at Lockheed Martin Astronautics in Denver for the Orbiter and Lander. Final compatibility testing of both the Orbiter and Lander are planned at Kennedy Space Center with the CCT near launch.

4 Frequency Assignments

Frequencies assigned to the Mars Surveyor 1998 Orbiter and Lander are given in the following table:

System	Uplink (MHz)	Downlink (MHz)	Polarization
Command	7175.027005	N/A	RCP
Telemetry transponder	N/A	8429.938271	RCP
Telemetry (noncoherent)	N/A	8427.222	RCP

NOTE: X-band uplink and downlink frequencies are the same for both spacecraft.

5 Support Parameters

5.1 Telemetry

5.1.1 Orbiter

Data streams	1
Modulation	BPSK
Subcarrier frequencies	320 kHz, 22.5 kHz
Science and engineering data plus Reed-Solomon encoding(sym/s)*	
Engineering data	10 b/s, 40 b/s, 100 b/s
Coding	Conventional (R=1/2, K=7 or R=1/6, K=15) and Reed-Solomon
Modulation index	Selectable

* Convolutional coding is also added, doubling the symbol rate transmitted to the ground.

5.1.2 Lander

Data streams	1
Modulation	BPSK
Subcarrier frequencies	22.5 kHz (prime), 360 kHz
Engineering and science(cruise)	10 b/s, 40 b/s, 100 b/s, 2100 b/s 10 b/s, 40 b/s, 350 b/s, 700 b/s, 1400 b/s

5.2 Command

Modulation	BPSK
Subcarrier frequency	16 kHz
Bit rates	500 b/s, 125 b/s (nominal), 62.5 b/s, 31.25 b/s, 15.625 b/s, or 7.8125 (emergency)

5.3 Support

DSN transmit power	20 kW HEF, 4 kW BWG
Angular rates	Planetary, except for initial near-Earth and early cruise

6 *Tracking Support Responsibility*

The assigned responsibility for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch (Delta)	Launch vehicle
Injection/Initial acquisition	DSN
Cruise/planetary	DSN

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National Oceanic and Atmospheric Administration-K, -L, -M, -N, -N' (NOAA-K, -L, -M, -N, -N')

TMS Manager:	E. Luers	**Launch Vehicle:**	Titan II
NOPE:	J.C. Green	**Range:**	WTR
Project Manager:	C. Thienel (GSFC)	**Launch Date:**	K: 2/16/98; L: 9/99; M, N, N': TBD
MOM:	W. Asplund (GSFC)	**Projected Spacecraft Life:**	2 yr
Project Responsibility:	GSFC	**DSN Support:**	2 yr
Sponsor:	NASA	**Source:**	DMR

1 Mission Description

The NOAA-K, -L, -M, -N, and N spacecraft provide an economical and stable platform for the advanced instruments to be used in making measurements of the Earth's atmosphere, its surface and cloud cover, and the proton and electron flux near the Earth. As part of the mission, the spacecraft will also have the ability to receive, process, and retransmit data from free-floating balloons and buoys, as well as remote automatic observation stations distributed around the globe and to track those stations in motion.

2 Flight Profile

The NOAA spacecraft will be launched from the Vandenberg Air Force Base (VAFB) Western range (WR) on a modified Titan II launch vehicle. The orbit characteristics will be a near-circular Sun-synchronous orbit.

3 Coverage

3.1 Coverage Goals

The DSN will support launch plus 21 d of backup to NOAA stations required for life of mission.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	**GDSCC**					**CDSCC**				**MDSCC**		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry				P	B				P			P
Command				P	B				P			P
Tracking				P	B				P			P
P = Prime, B = Backup												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2247.5	RCP
Command	2026.0	N/A	RCP
Tracking	N/A	2247.5	RCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM (biphase-l)/PM
Subcarrier	None
Bit rates	8.32 kb/s, 16.64 kb/s, 332.7 kb/s
Recording	Digital

5.2 Command

Format	PCM (NRZ-M)/PSK/PM
Bit rate	2.0 kb/s
Subcarrier frequency	16 kHz/s (sine wave)
Recording	Digital

5.3 Support

Uplink power	2 kW Nominal
Antenna:	
Rate	Moderate
Angle data	Not required
Autotrack	Yes
Doppler rates	Moderate
Range format	None
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	NOAA/DSN
Mission	NOAA
Emergency	DSN

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Near-Earth Asteroid Rendezvous (NEAR)

TMS Manager:	A.L. Berman	**Launch Vehicle:**	
NOPE:	A.B. Short	**Range:**	
Project Manager:	T. Coughlin (APL)	**Launch Date:**	2/17/96
MSM:	R. Farquhar (APL)	**Projected Spacecraft Life:**	4 yr
Project Responsibility:	APL	**DSN Support:**	4 yr
Sponsor:	NASA	**Source:**	MRR (Draft 4/94)

1 Mission Description

The NEAR project has the primary objective to orbit the near-Earth asteroid Eros in a 50-km orbit. The primary science objectives during the orbital phase about Eros are as follows:

- To measure the gross physical properties of the asteroid including size, shape, mass, density, and spin state.
- To determine the surface elemental and mineralogical composition with sufficient accuracy to enable comparisons with major meteorite types.
- To characterize the morphology of the asteroid surface.

2 Flight Profile

The NEAR Spacecraft was launched on 2/17/96, from the Kennedy Space Center, via a Delta II expendable launch vehicle. Two major trajectory correction maneuvers (TCM) are required to achieve the orbit about Eros; this occurs in February through March 1997 and January 1999 at Eros arrival. In addition, there is an Earth swingby in January 1998. There are a number of phases after arrival at Eros; however, they can be summarized as follows:

- Approach and initial reconnaissance orbit ranges from 3000 km to 100 km with a duration of 45 d.
- Science Mapping Orbit: 50 km and 265 d duration.
- Enhanced Science Mapping Orbit: 35 km and 100 d duration.

The primary mission ends on12/31/99.

3 Coverage

3.1 Coverage Goals

NEAR project coverage is primarily 34-m HEF or BWG, since the telecommunications links are X-band uplink and downlink only. Some small amount of 70-m coverage is anticipated for emergency and/or contingency support. The required 34-m HEF coverage is provided in the following table:

Mission Phase	Period	Passes/ Month	Pass Duration (h)
Launch	2/17/96 to 3/02/96	90	8
Deep space maneuver	3/05/97 to 3/15/97	90	8
Earth Swingby	12/22/97 to 2/22/98	90	8
Eros Rendezvous	12/01/98 to 3/01/99	90	8
Prime Science	3/01/99 to 12/31/99	90	8
Cruise	3/02/96 to 12/31/99	13	8 (70-m)

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (X-Band)	GDSCC		CDSCC		MDSCC	
	14	15	43	45	63	65
Telemetry	P*	P	P*	P	P*	P
Command	P*	P	P*	P	P*	P
Tracking	P*	P	P*	P	P*	P
P = Prime * Emergency/critical coverage						

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (X-Band)	Uplink (GHz)	Downlink (GHz)
Telemetry	N/A	8.40 to 8.44
Command	7.15 to 7.18	N/A

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	Biphase-L, NRZ-L/BPSK
Subcarrier	TBD
Bit rates	0.0138 kb/s, 0.1104 kb/s, 1.104 kb/s, 4.416 kb/s, 6.624 kb/s, 87.832 kb/s, 13.25 kb/s, 26.50 kb/s
Record	Required

5.2 Command

Format	TBD
Bit rate	125 b/s, 7.8125 b/s (emergency)
Subcarrier frequency	TBD

5.3 Support

Uplink power	20 kW
Antenna:	
Rate	1°/s
Angle data	Not required
Autotrack	Only at launch
Doppler rates	LEO rates
Range format	Standard DSN
Recording:	
Analog	Not required
Digital	Required

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	DSN
Cruise	DSN
Asteroid orbit	DSN

New Millennium Program, DS-1

TMS Manager:	R.D. Benson	**Launch Vehicle:**	TBD
NOPE:	B.G. Yetter	**Range:**	ETR
Project Manager:	D. Lehman	**Launch Date:**	7/1/98
MOM:	P. Varghese	**Projected Spacecraft Life:**	2 yr
Project Responsibility:	JPL	**DSN Support:**	2 yr (plus possible 2 yr extended mission)
Sponsor:	NASA	**Source:**	Draft MRR (4/94)

1 Mission Description

DS-1 is a technology demonstration mission with secondary scientific objectives. The success of the mission will be judged on demonstration of technologies for use by future missions rather than on science return. These technologies include solar electric propulsion (SEP), miniaturization of spacecraft subsystems and scientific instruments, autonomous navigation, autonomous operations, and others. Key events include an asteroid flyby (February 1999) and a comet flyby (June 2000).

2 Flight Profile

DS-1 will be launched on 7/1/98 (nominally) from the Eastern test range using a TBD expendable launch vehicle. The mission includes two flyby encounters, with asteroid 3352 McAuliffe in February 1999 and comet West-Kohoutek-Ikemura in June 2000. DS-1 utilizes SEP, and the spacecraft is under nearly continuous acceleration throughout the mission. The maximum range to the spacecraft will be approximately 2.6 AU.

3 Coverage

3.1 Coverage Goals

Support for DS-1 will be provided by the 34-m BWG network as shown in the table below. Primary communications will be accomplished using standard X-band transmit/receive capabilities. DSS 25 will provide Ka-band receive capability as a technology demonstration. The network will also support demonstration of “beacon mode” using DSS 13 equipped with a spectrum analyzer. Large-aperture coverage will be required only for emergencies or other unanticipated contingencies. Refer to the following table:

Mission Phase	Date	Passes/ Month	Antenna
Initial checkout	L to L+10 d L+10 to L+30 d L+30 to L+60 d	90 30 12	34-m BWG 34-m BWG 34-m BWG
Cruise	L+60 d to L+6.5 mo	4	34-m BWG
Asteroid flyby	L+6.5 mo to L+7 mo	90	34-m BWG
Cruise	L+7 mo to L+22.5 mo	4	34-m BWG
Comet flyby	L+22.5 mo to L+23.5 mo	90	34-m BWG
Cruise	L+23.5 mo to EOM	4	34-m BWG
NOTE: All passes are assumed to be 8 h or more in duration.			

3.2 Network Support

DSN support will be provided as indicated in the following table:

System (X-Band)	GDSCC		CDSCC		MDSCC	
	24	25		34		54
Telemetry		P		P		P
Command		P		P		P
Ka-band		P				
P = Prime						

4 Frequency Assignments

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)	Polarization
X-band:			
Telemetry	N/A	8421.8	RCP
Command	7168	N/A	RCP
Tracking	8421.8	N/A	RCP
Ka-band:			
Telemetry	32155.9	N/A	RCP

5 Support Parameters

5.1 Telemetry

Data streams	2 subcarriers plus 4 tones used for beacon mode
Format	CCSDS (PCM/PM/PSK)
Subcarrier frequencies	25 kHz, 375 kHz, square wave beacon tones at 20 kHz, 25 kHz, 30 kHz, 35 kHz
Bit rates:	
HGA	1.8 to 40 kb/s
LGA	10 b/s to 2 kb/s
Coding	Viterbi with (15, 1/6) convolutional code, and Reed-Solomon with TBD interleave depth
Recording	Required

5.2 Command

Format	CCSDS (PCM/PM/PSK)
Bit rate	7.8125 b/s to 2000 b/s
Subcarrier:	
Frequency	16 kHz
Waveform	Sine

5.3 Support

Uplink power	4 kW
Antenna:	
Rate	Near sidereal except during launch phase
Angle data	TBD
Autotrack	Conscan required
Doppler rates	TBD
Range format	DSN standard
Recording:	
Analog	TBD
Digital	TBD
VLBI	TBD

6 Tracking Support Responsibility

The responsibility for tracking support for all mission phases belongs to the DSN.

Ocean Topography Experiment (TOPEX/Poseidon) (Emergency Support)

TMS Manager:	A.L. Berman	**Launch Vehicle:**	Ariane
NOPE:	J.C. Green	**Range:**	CSG
Project Manager:	C. Yamarone	**Launch Date:**	8/10/92
MOM:	R. Stiver	**Projected Spacecraft Life:**	6 yr
Project Responsibility:	JPL	**DSN Support:**	6 yr
Sponsor:	NASA	**Source:**	SIRD Rev. A (1/90); NSP (3/92)

1 Mission Description

The TOPEX Mission consists of a single TOPEX spacecraft which was placed in a high circular Earth orbit, with an altitude of 1334 km and a 63° inclination. Earth tracks repeat every 10 d. Using an altimeter, TOPEX maps the topography of the ocean's surface to obtain scientific data for use in determining global ocean circulation patterns.

Of particular interest to JPL is the Global Positioning Satellite (GPS) demonstration. Receivers and media calibration equipment at the DSS Media Calibration Subsystem at the three DSN complexes augment the GPS system to provide a differential GPS data type, which is used for precision orbit determination. With three DSN sites, 15-cm accuracy was anticipated. If three additional sites are acquired, 10-cm or better accuracy is expected.

2 Flight Profile

The TOPEX spacecraft was launched from the Centre Spatial de Guiana in French Guiana on 8/10/92, via an Ariane launch vehicle.

3 Coverage

3.1 Coverage Goals

Launch support was provided by the 26-m subnet. Emergency support will be provided by the DSN 26-m subnet as required for backup support of TDRS.

3.2 GPS Space Vehicle Coverage

The DSS media calibration subsystem will provide continuous coverage of the constellation of GPS space vehicles (GPS SV). The constellation will have between 18 and 24 satellites.

3.3 TOPEX GPS Receiver Coverage

Radio metric data acquired by the GPS receiver on TOPEX comes to JPL through the TDRS telemetry link.

4 Frequency Assignments

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)	Polarization
GPS L2	N/A	1227.60	RCP
GPS L1	N/A	1575.4	RCP

All GPS SVs transmit on the same two frequencies. Each GPS SV is assigned unique orthogonal PN codes that modulate the carriers and allow a ground receiver to separate the signals from individual GPS SVs.

The international GPS global network consists of six stations, all of which are equipped with GPS receivers and their connections to communication links with the appropriate operations center. For this mission the operations center is at JPL. Three of the sites are at the existing deep space stations, namely Goldstone, California; Tidbinbilla, Australia; and Robledo, Spain. The additional three sites are at Usuda, Japan, which is the location of its 64-m deep space station; Hartebestock, South Africa, which operates by French network stations with headquarters in Toulouse, France; and the former STDN complex 35 miles north of Santiago, Chile. For this project the interface for the data from South Africa is at Toulouse.

The three additional sites will be covered by letters of agreement between NASA and the indigenous agencies, namely the Institute of Space & Astronautical Sciences, Tokyo, Japan; the French network (CNES), which will be responsible for acquiring the data in South Africa and transmitting it to NASA/JPL; and the University of Chile in Santiago, which has acquired all of the NASA STDN facilities and will maintain and operate the NASA equipment on loan and transmit the data to NASA/JPL.

The JPL DSN will assume the lead role as GPS network coordinator, with responsibility to initiate, facilitate, negotiate, and otherwise successfully execute all joint network operational aspects, including planning, documentation, configuration, communications, and monitor and control, of the joint DSN International Agencies GPS 6-station network.

5 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Ariane launch	GSG
High Earth orbit	TDRS
Emergency support	DSN
GPS demonstration support	DSN

Planet-B Mission

TMS Manager:	A.F. Chang	**Launch Vehicle:**	M-V
NOPE:	S. Waldherr	**Range:**	KSC, Japan
Project Manager:	K. Tsuruda (ISAS)	**Launch Date:**	July 3,1998
MOM:	K. Ninomiya (ISAS)	**Projected Spacecraft Life:**	2 yr
Project Responsibility:	ISAS	**DSN Support:**	Critical maneuvers, Through MOI, Mission phase telemetry support (TBD)
Sponsor:	ISAS	**Source:**	NOWG (5/96)

1 Mission Description

Planet-B is Japan's first planetary mission. The objective of the mission is to study the structure and dynamics of the Martian atmosphere, including its interaction with the solar wind and dust, and the Martian magnetic field. Experience gained will help develop advanced technology, in planetary orbit insertion, deep space communications and autonomous control, to be used in the future planetary missions. Launch is scheduled for August 1998 by the third M-V rocket. Trans-Mars orbit insertion follows the two Lunar swingbys in September and December of 1998, and Mars Orbit Insertion will be in October of 1999.

The spacecraft is 2 m in diameter and has a dry weight of 258 kg and about 33 kg of science payloads. It is spin stabilized, Earth pointing with 8-s spin period. The mission orbit has an inclination of 138° with 150 km periapsis and 15 Mars radius (Rm) apoapsis. Aside from the neutral mass spectrometer (NMS) provided by NASA/GSFC, there are 13 other science payloads contributed by Canada, Germany, Japan, and Sweden.

2 Flight Profile

Planet-B is scheduled to be launched from the KSC in southern Japan, by the M-V launch vehicle in August 1997. After launch, the spacecraft will be inserted in to a low-Earth circular parking orbit at 200 km altitude. It will then be injected into a highly eccentric transfer orbit by the fourth stage kick motor, with the apogee of 410,000 to 430,000 km and the perigee of 600 to 1,200 km, for about 49 d. After 2 Lunar swingbys and the fourth Delta V maneuver, it will escape from the Earth in December 1998 and will be inserted into the trans-Mars orbit. After about 10 mo voyage, the spacecraft will then be injected into Mars revolving orbit in October 1999. The final periareon altitude will be around 150 km and apo-areon distance of 15 Rm (mean Rm is 3,397 km). The inclination will be 138° and the orbital period will be about 38 h.

3 Coverage

3.1 Goals

DSN will support all the critical maneuvers (i.e., Delta V, lunar swingby, Mars orbit insertion (MOI), and post MOI, by performing orbit determinations from DSN tracking data and provide intercenter vectors (ICV) to ISAS. Telemetry support during mission operations phase, which will double or triple the science return, depending on the amount of support, is under negotiation between NASA and ISAS. Radio science data acquisition support is also being negotiated between NASA HQ and ISAS.

3.2 Network Support

DSN support will be provided as indicated in the following table:

System (S-Band)	GDSCC				CDSCC				MDSCC			
	14	15	16	24	42	43	45	46	61	63	66	54
Telemetry	B			P						B		P
Command												
Tracking			P	B					B	P	P	B
B = Backup, P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2293.9	RCP
Command	N/A	N/A	N/A
Tracking	2112.3	2293.9	RHCP
X-Band		8410.9	RHCP

5 Support Parameters

5.1 Telemetry

The following is a listing of X-band telemetry support parameters:

Modulation format	PCM-PM
Modulation index	1.2 rad
Subcarrier frequency	N/A
Bit Rate	2048-32768 b/s
Coding	Concatenated, (R-S + convolutional)
BER	1.0 x 10 (-5)

The following is a listing of the S-band telemetry support parameters:

Modulation format	PCM-PSK-PM
Subcarrier frequency	0.7 rad
Bit Rate	8192 Hz
Coding	64-1024 b/s
BER	Concatenated, (R-S + convolutional)

5.2 Command

N/A

5.3 Radiometric

Uplink power	1-10 kW
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes (26-m only)
Doppler rates	Moderate
Range format	516 kHz square wave
Recording	
Analog	N/A
Digital	Required

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	KSC
Earth orbit	UDSC/KSC/DSN
Mars transfer orbit	UDSC/KSC/DSN
MOI/post-MOI	UDSC/KSC/ DSN
Mars orbit/mission operations	UDSC/KSC/DSN (TBD)

Radarsat

TMS Manager:	E.B. Luers	**Launch Vehicle:**	Delta
NOPE:	J.C. Green	**Range:**	WR
Project Manager:	Dr. S. Ahmed (CSA)	**Launch Date:**	11/4/95
S-Band Coordinator:	D. Andean (CSA)	**Projected Spacecraft Life:**	5.25 yr
Project Responsibility:	CSA	**DSN Support:**	5.25 yr
Sponsor:	CSA	**Source:**	DMR

1 Mission Description

Radarsat is a cooperative program of the Canadian Space Agency (CSA),NASA, and the National Oceanic and Atmospheric Administration (NOAA), to obtain remote sensing information about the Earth from space. The Radarsat carries a single instrument, a C-band synthetic-aperture radar (SAR).

2 Flight Profile

The Radarsat spacecraft was launched from the Vandenberg Air Force Base (VAFB) Western range (WR) on a Delta II launch vehicle. The orbit characteristics are a near-circular Sun-synchronous orbit with an inclination of 98.6°.

3 Coverage

Launch and early orbit support, approximately 90 d, is provided by the 26-m subnetwork and other NASA/NOAA-provided stations. The project is e supporting two Antarctic SAR surveys which require two 30-d coverage periods. Emergency support is being provided by the 26-m subnet, and other stations as required, during the life of the mission.

System (S-Band)	GDSCC		CDSCC				MDSCC			Santiago	Weilheim		Poker Flat (WFF)	Fairbanks (NOAA)
	16	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**	**74**	**58**	**59**	**29**	**92**
Telemetry	P	B				P			P	P	P	B	B	P
Command	P	B				P			P	P	P	B	B	P
Tracking	P	B				P			P	P	P	B	B	P
B = Backup, P = Prime														

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2230.0	RHC
Command	2053.458	N/A	RHC
Tracking	2053.458	2230.0	RHC

5 Support Parameters

5.1 Telemetry

Data streams	2
Format	PCM(biphase-L)/PM PCM(biphase-L)/PSK/PM
Subcarrier frequency	1.024 MHz (sine wave)
Bit rate	0.5 kb/s, 2 kb/s, 4 kb/s, 32 kb/s, or 128 kb/s
Coding	None
Recording	Digital

5.2 Command

Format	PCM(NRZ-M)/PSK/PM
Subcarrier frequency	16 kHz (sine wave)
Bit rate	2 kb/s

5.3 Support

Uplink power	16 W
Antenna:	
Rate	High
Angle data	Required
Autotrack	Yes
Doppler rates	High
Range format	Tone
Recording	Digital

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the table below:

Mission Phase	**Support Responsibility**
Launch	GSFC
Early Orbit	DSN
Mission	CSA
Emergency	DSN

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Roentgensatellit (ROSAT)

TMS Manager:	J.M. Stewart	**Launch Vehicle:**	Delta II
NOPE:	S. Waldherr	**Range:**	CCAPS
Project Manager:	G. Ousley (GSFC)	**Launch Date:**	6/1/90
MOM:	F. Guckenbiehl (GSOC)	**Projected Spacecraft Life:**	8 yr 6 mo
Project Responsibility:	GSFC (BMFT cooperative)	**DSN Support:**	8 yr 6 mo
Sponsor:	OSC	**Source:**	GSFC Project Plan (10/83), other project documents

1 Mission Description

ROSAT is an international cooperative program between NASA and the Bundesministerium für Forschung und Technologie (BMFT) of the Federal Republic of Germany. Germany developed and provided a spacecraft with an X-ray telescope featuring two instruments at the focal plane of the telescope, and a stand-alone wide-field X-ray camera (WFC) was provided by the United Kingdom (UK). NASA provided one instrument: a high-resolution X-ray Imager (HRI) for mounting in the focal plane similar to the high-energy astronomy observatory (HEAO)-2 HRI. NASA launched the satellite on a Delta II vehicle in June 1990.

ROSAT made an all-sky survey of X-ray and extreme ultraviolet (EUV) sources, using redundant German position-sensitive proportional counters (PSPC) and the British WFC during the first 6 mo of its orbital mission while in a scan mode. The next 12 mo was dedicated to detailed measurements of selected X-ray sources employing the U.S. HRI, the German PSPC, and the U.K. WFC in a stationary or pointing mode of spacecraft operation.

In the scan mode, the spacecraft maintains the telescope axis approximately normal to the Earth (i.e., one spacecraft rotation per orbit). In the pointing mode, the spacecraft is in a 3-axis stabilized with the telescope pointing to a particular X-ray source for long periods of time (10^3 to 10^4 s).

A Memorandum of Understanding (MOU) setting forth the international agreement between NASA and the BMFT for the joint accomplishment of the ROSAT program was signed on 8/8/82.

2 Flight Profile

The ROSAT was launched from the Cape Canaveral Air Force station on a Delta II expendable launch vehicle and placed in a circular orbit at an altitude of 580 km, with a 53° inclination.

3 Coverage

3.1 Goals

The support planned by the DSN for ROSAT is provided in the following table:

Mission Phase	Period	Passes Per Month	Antenna
Pointing	2/91-2/92	60	26-m
Extended mission support	2/92-2/95	60	26- m

3.2 Network Support

The DSN will provide prime support from spacecraft release from the Delta II through L+28 d. The DSN will provide backup support to Weilheim for the duration of the mission. This support will normally be provided by the DSN 26-m stations and will only be provided as specifically required by the project, German Space Operations Center. The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC				CDSCC				MDSCC		
	12	14	15	16	42	43	45	46	61	63	66
Telemetry				P/B				P/B			P/B
Command				P/B				P/B			P/B
Tracking				P/B				P/B			P/B
P/B = Prime or backup depending on the mission phase.											

4 Frequency Assignments

The uplink frequency for ROSAT is 2096.27 MHz and the downlink frequency is 2276.50 MHz (RCP or LCP).

5 Support Parameters

5.1 Telemetry

Data streams	2 (8 kb/s only supported by DSN)
Modulation	PCM/biphase-L/PM
Subcarrier	None (directly on carrier)
Bit rates	8 kb/s by DSN 1 Mb/s science data supported only by Weilheim

5.2 Command

Modulation	PCM/PSK/PM
Subcarrier frequency	16 kHz
Bit rate	1 kb/s

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Delta II launch-to-orbit	GSFC
Mission support:	
Prime spacecraft	Weilheim/DSN*
Backup spacecraft	DSN

* Selected prime support for the first 4 wk after launch.

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Rossi X-Ray Timing Explorer (RXTE) (Emergency Support)

TMS Manager:	E.B. Luers	**Launch Vehicle:**	Delta II
NOPE:	J.C. Green	**Range:**	ETR
Project Manager:	D. Schulz (GSFC)	**Launch Date:**	12/30/95
MOM:	J. Joyce (GSFC)	**Projected Spacecraft Life:**	3 yr
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	NASA	**Source:**	DMR (4/93)

1 Mission Description

The RXTE studies a variety of X-ray sources, including white dwarfs, accreting neutron stars, black holes, and active galactic nuclei. Measurements are made over a wide range of photon energies from 2 to 200 keV. The RXTE consists of three instruments: the proportional counter array (PCA); the all sky monitor (ASM); and the high-energy X-ray timing experiment.

The RXTE observatory was launched into orbit on a Delta II 7920 ELV. The instruments are mounted on a spacecraft bus.

2 Flight Profile

The RXTE was placed in a circular orbit by an expendable launch vehicle.

Orbit: Circular, 600-km altitude x 23° inclination (design orbit). Period = 96 min.

3 Coverage

3.1 Goals

DSN coverage for the RXTE will be provided during emergencies that would prevent communications via the normal TDRSS White Sands link. Emergency support will be provided by the DSN's 26-m antenna subnetwork.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				E	E				E			E
Command				E	E				E			E
Tracking				E	E				E			E
E = Emergency support												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2287.5	RHC
Command	2106.4	N/A	RHC

5 Support Parameters

5.1 Telemetry

Data Streams	1
Format	PCM (biphase-L) PM
Subcarrier frequency	N/A
Bit rates	32 kb/s or 1024 kb/s Reed-Solomon (252,220) interleave depth of 5
Recording	Digital

5.2 Command

Format	PCM(NRZ-M)PSK/PM
Subcarrier frequency	16 kHz (sine wave)
Bit rate	2 kb/s
Recording	Digital

5.3 Support

Uplink power	2 kW
Antenna:	
Rate	Moderate
Angle data	N/A
Autotrack	
Doppler rates	Moderate
Range format	N/A
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibility for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	GSFC
Early orbit	GSFC/DSN
Mission	GSFC
Emergency	DSN

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SAMPEX

TMS Manager:	E.B. Luers	**Launch Vehicle:**	Scout
NOPE:	L. Weinberg	**Range:**	VAFB
Project Manager:	P. Pashby (GSFC)	**Launch Date:**	7/3/92
POD:	K. Hartnett (GSFC)	**Projected Spacecraft Life:**	5 yr
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	NASA	**Source:**	DMR

1 Mission Description

GSFC developed the SMEX program, managed by the Special Payloads Division (SPD) (Code 740), to provide frequent flight opportunities for highly focused and inexpensive space science missions. SAMPEX is the first mission of the SMEX program. Its primary scientific objectives are to measure the elemental and isotopic composition of solar energetic particles, anomalous cosmic rays, and galactic cosmic rays over the energy range from approximately 1 to several hundred MeV per nucleon. By determining the dependence of the fluxes on geomagnetic cutoff rigidity over the polar orbit, the ionization state of the anomalous component will be determined, along with the mean ionization state of solar energetic particles. The dependence of these fluxes on the solar activity cycle will be measured by carrying out continuous observations over an extended (3-yr) portion of the current activity cycle. A further primary objective is to determine flux levels and local time dependence of relativistic precipitating magnetospheric electrons during a period of declining solar activity.

2 Flight Profile

SAMPEX was launched June 1992, using a four-stage Scout launch vehicle into a nominal elliptical orbit of 450 by 850 km with an inclination of 82° (not Sun-synchronous) and a period of 98 min.

3 Coverage

3.1 Goals

DSN will support two contacts per day (12 h apart), low-rate telemetry, command, and tracking. DSN will also provide backup support to Wallops for high-rate telemetry dumps.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				P	B				P			P
Command				P	B				P			P
Tracking				P	B				P			P
B = Backup, P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2215.0	LCP
Command	2039.65	N/A	LCP
Tracking	N/A	2215.0	LCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM (NRZ-L)/Biphase-L/PM
Subcarrier	None
Bit rates	4, 16, and 900 kb/s
Coding	Convolutional (K=7, R=1/2) CCSDS virtual channels (VC) 4 kb/s and 16 kb/s - provided asynchronously in real time 900 kb/s - VC 0 provided synchronously in real time; composite 900 kb/s provided asynchronously during playback
Recording	Digital

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Bit rate	2.0 kb/s
Subcarrier frequency	16 kHz (sine wave)
Recording	Digital

5.3 Support

Uplink power	2 kW nominal
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes
Doppler rates	Moderate
Range format	Tone (sine)
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Mission	WFF/DSN
Emergency	DSN

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Sirius-2
(Reimbursable)

TMS Manager:	P.T. Poon	**Launch Vehicle:**	N/A
NOPE:	S. Waldherr	**Range:**	N/A
Project Manager:	J. Dulac (CNES)	**Launch Date:**	11/12/97
Network Manager:	J. Trebaol (CNES)	**Projected Spacecraft Life:**	12 yr
Project Responsibility:	CNES	**DSN Support:**	3 d
Sponsor:	CNES	**Source:**	Prelim DMR (8/96)

1 Mission Description

The Sirius-2 mission will provide direct television data broadcast and business communication services for the benefit of the Scandinavian NSAB/SSC. It will replace the aging TELE-X satellite and will be located at 5 east longitude. NASA support has been successfully completed for SIRIUS-2. No further support is anticipated.

2 Flight Profile

The Sirius-2 satellite will be launched from the Centre Spatial Guyanis in French Guiana on an Ariane-4 launch vehicle. The mission will follow the typical injection sequence: parking orbit, transfer orbit, and drift orbit. Apogee kick motor (AKM) firings will be performed to raise the spacecraft perigee. Drift phase orbital and attitude maneuvers will be performed to place the spacecraft in its final geostationary orbit (apogee=perigee=24458 km.)

3 Coverage

The DSN supported the transfer and drift orbit mission phases.

3.1 Goal

The coverage was provided by the 26-m antenna at Canberra for launch and critical support coverage during the transfer and drift orbits. Support consisted of one 9-hour track on orbits 1, 3, and 5, with a 1-d contingency on orbit 7.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	CDSCC			
	42	43	45	46
Telemetry				P
Command				P
Tracking				P
B = Backup, P = Prime				

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2209.006	RCP/LCP
Command	2034.126	N/A	RCP/LCP
Tracking	2034.126	2209.006	RCP/LCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM (SP-L)/PSK/PM
Subcarrier frequency	32.768 Hz
Bit rates	4096 b/s (conventional viterbi)
Coding	N/A
Record	Required

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Subcarrier frequency	8000 Hz
Bit rate	500 b/s

5.3 Support

Uplink power	1 to 2 kW
Antenna:	
Rate	Moderate
Angle rate	Required
Autotrack	Yes (26-m only)
Doppler rates	Modest
Range format	Tone (prime) (100-kHz major tone) DSN standard (backup)
Recording:	
Analog	N/A
Digital	Required

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table.

Mission Phase	Support Responsibility
Ariane-4 launch	KRU/AUS/HBK/AGO
Transfer/Drift orbits	KRU/HBK/AUS/AGO
Geostationary orbit	CNES

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Space Infrared Telescope Facility (SIRTF)

TMS Manager:	P.E. Beyer	**Launch Vehicle:**	Delta II
NOPE:	B.G. Yetter	**Range:**	ETR
Project Manager:	L. Simmons	**Launch Date:**	12/01/01
MOM:	M. Ebersole	**Projected Spacecraft Life:**	5 yr
Project Responsibility:	JPL	**DSN Support:**	5 yr
Sponsor:	NASA	**Source:**	MRR

1 Mission Description

The Space Infrared Telescope Facility (SIRTF) will provide unprecedented sensitivity to explore the birth and evolution of the universe. It will give the nation the chance to display some of its premier technologies in fundamental scientific applications of very general interest, such as the search for other solar systems and for the earliest stages in the formation of galaxies similar to our own Milky Way.

SIRTF will carry three instruments: the infrared array camera (IRAC), the infrared spectograph (IRS), and the multi-band imaging photometer for SIRTF (MIPS).

2 Flight Profile

SIRTF will be launched on a Delta II from the Easter test range. Current plans are to place it in a heliocenteric orbit that trails the Earth at a rate of 0.11 AU per year.

3 Coverage

3.1 Goals

Continuous coverage is required during the launch and checkout phase. During the observation phase, ground contacts will be every 12 h. Data dumps of up to 4 Gb of data will occur at 2.2 Mb/s via the HGA. The required coverage for the various phases of the mission is shown in the following table.

Mission Phase	Date(s)	Passes/Month	Antenna(s)
Launch/In-orbit checkout	L to L+60 d	90[a]	34-m HEF or BWG
Observation	L+60 d to 2.25 yr	60[b]	34-m HEF or BWG
Observation	2.25 yr to 5 yr	60[b]	34-m HEF or 70-m

[a] 8-h passes
[b] 30-min passes
[c] 1-h passes
[d] 2-h passes

3.2 Network Support

DSN support will be provided as indicated in the following table:

System (X-Band)	GDSCC				CDSCC			MDSCC		
	14	15	25	26	42	45	34	63	65	54
Telemetry	P	P	B	B	P	P	B	P	P	B
Command/RMD	P	P	B	B	P	P	B	P	P	B
B = Backup, P = Prime										

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (X-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	TBD	TBD	TBD
Command	TBD	TBD	TBD
Tracking	TBD	TBD	TBD

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	TBD
Subcarrier frequency	N/A
Bit rate	40 b/s to 2.2 Mb/s
Coding	Convolutional (R=1/2, K=7 or R=1/6, K=15)

5.2 Command

Format	TBD
Bit rate	7.8125 b/s to kb/s
Subcarrier frequency	TBD

5.3 Support

Uplink power	4 kW or 20 kW
Antenna:	
Rate	Sidereal
Angle data	Not required
Autotrack	Not required
Doppler rates	Moderate
Range format	None

6 Tracking Support Responsibility

The responsibility for tracking support for all phases belongs to the DSN.

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Space Technology Research Vehicle (STRV 1-a and 1-b)

TMS Manager:	P.B. Beyer	**Launch Vehicle:**	Ariane 4 (GTO)
NOPE:	J. Green	**Range:**	Kourou
Project Manager:	A. Hooke	**Launch Date:**	6/17/94
MOM:	R. Davis	**Projected Spacecraft Life:**	5 1/2 yr
Project Responsibility:	JPL/University of Colorado	**DSN Support:**	5 1/2 yr

1 Mission Description

The purpose of the STRV mission is to:

(1) Provide an in-orbit demonstration of the performance of several new and advanced technologies.

(2) Conduct a number of experiments related to the hazards facing spacecraft in general, once in orbit.

(3) Place in orbit several experiments that are of specific relevance to the Ballistic Missile Development Organization

STRV 1-a: Compare the CREDO radiation detector to the REM and radmon detectors on the STRV-1b spacecraft.

STRV 1-b: Fly four experiments to gain space flight and radiation effects data to aid in their qualification for NASA and SDIO space missions. The experiments are:

- Vibration damping for stirling cryo coolers
- Neural net chip
- HIP IR detector
- SRAM total radiation dose monitor

In the extended mission, STRV 1-b will also be operated as a flying testbed for new standard data communication protocols.

2 Flight Profile

The STRV 1-a and 1-b satellites were launched into a highly elliptical geostationary transfer orbit (300 x 36,000 km), in which they will remain throughout the mission.

3 Coverage

The objective is to acquire all of the STRV data as often as 1/d. The 26-m subnet will provide support for up to one pass per day per spacecraft. Nominal support will be 7 passes per week per spacecraft.

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				P	P				P			P
Command				P	P				P			P
B = Backup, P = Prime												

4 Frequency Assignments

The frequencies for STRV 1-a and STRV 1-b are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2273.76	Linear
Command	2093.75	Linear	N/A

5 Support Parameters

5.1 Telemetry

Data streams	1 each vehicle
Format	Biphase-L/PSK
Subcarrier frequency	None
Bit rate	1000 b/s, 500 b/s
Coding	None

5.2 Command

Format	PCM/PSK/PM/NRZ-L
Bit rate	125 b/s
Subcarrier:	
Frequency	8000 Hz
Waveform	Sine wave

5.3 Support

Uplink power	Up to 2 kW
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes
Doppler rates	Up to 20 Hz/s

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Space Transportation System (STS) (Emergency Support)

TMS Manager:	R. Gillette	**Launch Vehicle:**	STS
NOPE:	D. Durkee	**Range:**	ETR
Project Manager:	L. Nicholson (JSC)	**Launch Date:**	Ongoing; Operational date (9/29/88)
MSM:	R. Stelmaszek (GSFC)	**Projected Spacecraft Life:**	10 yr
Project Responsibility:	JSC	**DSN Support:**	10 yr
Sponsor:	NASA	**Source:**	PID (7/79)

1 Mission Description

STS is a manned reusable launch vehicle (shuttle) used to carry into space payloads for NASA, military, private industry, universities, research organizations, and foreign governments and organizations.

2 Flight Profile

STS is launched from the Eastern test range (ETR). Solid launch rocket engines are separated and recovered downrange for reuse. Landings take place at the ETR or at Edwards Air Force Base.

3 Coverage

3.1 Goals

Coverage is provided by the DSN for the STS during launch, landing, and in-flight emergencies that would prevent communications between the Shuttle and the White Sands TDRSS receiving station. Emergency support would be provided by the DSN's 26-m subnetwork and the Goldstone 9-m antenna.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	**GDSCC**					**CDSCC**				**MDSCC**		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry				B	P				P			P
Command				B	P				P			P
Tracking				B	P				P			P
B = Backup, P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)
Telemetry	N/A	2217.5 2287.5
Command	2041.9 2106.4	N/A
Tracking	2041.9 2287.5	2217.5 2106.4

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PM (FM P/B)
Subcarrier frequency	N/A
Bit rates	64 kb/s, 96 kb/s, 128 kb/s, 192 kb/s, 1024 kb/s
Record	1024 kb/s

5.2 Command

Format	Baseband
Subcarrier frequency	N/A
Bit rate	72 kb/s, 32 kb/s

5.3 Support

Uplink power	2 kW or 200 W
Antenna:	
Rate	High
Angle rate	Required
Autotrack	Yes
Doppler rates	Moderate
Range format	Major tone
Recording:	
Analog	Required
Digital	Required

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table.

Mission Phase	Support Responsibility
Launch and landing	KSC
Flight	JSC/TDRS
TDRSS emergency	DSN

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Stardust

TMS Manager:	F.W. Miller	**Launch Vehicle:**	Delta
NOPE:	D. Reece	**Range:**	ETR
Project Manager:	K. Atkins	**Launch Date:**	2/15/99
MOM:	T. Duxbury	**Projected Spacecraft Life:**	7 yr
Project Responsibility:	JPL	**DSN and MGSO Support:**	7 yr

1 Mission Description

The Stardust mission will use an Earth gravity-assist flyby in January 2001 to achieve a trajectory for a rendezvous with the comet Wild 2 in January 2004. While near the comet, it will collect thousands of particles of cometary material in its aerogel collection plate. It will also perform gas analysis and take high-resolution images of the comet nucleus. The back side of the aerogel collection plate will also be used during several cruise periods to collect samples of interplanetary dust particles. The spacecraft will then return to the vicinity of Earth, and its Sample Recovery capsule will reenter the atmosphere in January 2006, making a parachute landing in Utah.

2 Flight Profile

The Stardust spacecraft, the fourth Discovery Class mission, will be launched in January or February 1999 from the Eastern Range, with direct injection into a heliocentric orbit. The first of three trajectory correction maneuvers (TCM) will be performed in March 2000, followed by one Earth gravity assist flyby in January 2001 and two small TCMs in January 2002 and June 2003. The flyby of wild 2 occurs in February 2004, and the capsule return occurs in January 2006.

Altogether, three orbits will be made around the Sun, in order to minimize the Delta-V requirements for the mission. Collection of interstellar dust will be attempted on three aphelion legs of the transfer trajectory. The comet encounter takes place at 1.86 AU from the Sun, 75 d after perihelion of wild 2. A flythrough of the comet's coma is planned on the Sun side, at a miss distance of about 100 km.

3 Coverage

The DSN and the Multimission Ground Systems Office (MGSO) will support all phases of the mission, including assembly and test operations at Lockheed Martin Astronautics, launch, cruise, encounter, and Earth return.

3.1 Coverage Goals

Tracking needs for Stardust are modest. The majority of the mission is flown with 34-m beam waveguide antennas at X-band. Launch, comet encounter, and Earth return are high-intensity periods. The comet encounter will use optical navigation to target the flyby. The use of 70-m antennas at comet encounter is requested to reduce single-event risk and to downlink data quickly. The long cruise requires only minimum communication activity, one track per week. Initial acquisition will be at Canberra. The required coverage for the mission duration is:

Launch phase	Continuous coverage to one 8-hour pass per day
Maneuvers	Two 8-hour passes per week
Cruise phase	One 8-hour pass per week
Encounter phase	Continuous coverage to one 8-hour pass per day
Return phase	One 8-hour pass per day

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC	CDSCC	MDSCC
	15	**45**	**65**
Telemetry	P	P	P
Command	P	P	P
Tracking	P	P	P
P = Prime			

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (X-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	TBD	TBD	TBD
Command	TBD	TBD	TBD
Tracking	TBD	TBD	TBD

5 Support Parameters

5.1 Telemetry

Data streams	TBD
Format	TBD
Subcarrier frequency	TBD
Bit Rates	TBD
Recording	TBD
Coding	TBD

5.2 Command

Format	TBD
Bit rate	TBD
Subcarrier:	
Frequency	TBD
Waveform	TBD

5.3 Support

Uplink power	TBD
Antenna:	
Rate	TBD
Angle data	TBD
Autotrack	TBD
Doppler rates	TBD
Range format	TBD
Recording	TBD

6 Tracking Support Responsibility

The assigned responsibility for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	ETR/MGSO/DSN
Mission	DSN
Emergency	DSN

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Submillimeter Wave Astronomy Satellite (SWAS)

TMS Manager:	E.B. Luers	**Launch Vehicle:**	Pegasus-XL
NOPE:	L. Weinberg	**Range:**	VAFB
Project Manager:	D. Betz (GSFC)	**Launch Date:**	3/19/97
DSOPM:	J. Catena (GSFC)	**Projected Spacecraft Life:**	3 yr
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	NASA	**Source:**	DMR

1 Mission Description

SWAS is a SMEX follow-on mission designed to study molecular clouds in the galactic plane, providing a minisurvey and a full survey of the clouds, leading toward the development of maps.

2 Flight Profile

The SWAS spacecraft will be launched on a Pegasus small expendable launch vehicle (SELV) from Wallops Flight Facility (WFF)/ER.

3 Coverage

3.1 Goals

DSN will support launch and early orbit phases (approximately 5 d). The DSN may be required as backup to Wallops and Poker Flats.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry				P	B				P			P
Command				P	B				P			P
Tracking				P	B				P			P
B = Backup, P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	2215.00	LHC	N/A
Command	2039.65	LHC	N/A
Tracking	2039.55	2215.00	LHC

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM/NRZ-L/Biphase-L/PM
Subcarrier	None
Bit rates	18.75 and 900 kb/s
Coding	Convolutional (K=7, R=1/2)
Recording	Digital

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Bit rate	2.0 kb/s
Subcarrier frequency	16 kHz (sine wave)
Recording	Digital

5.3 Support

Uplink power	2 kW nominal
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes
Doppler rates	Moderate
Range format	Tone
Recording	Digital

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	GSFC/DSN/WFF
Mission	DSN/WFF
Emergency	DSN

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Summer Undergraduate Research Fellowship Satellite Number 1 (SURFSAT-1)

TMS Manager:	A.L. Berman	**Launch Vehicle:**	Delta II
NOPE:	A.B. Short	**Range:**	VAFB
Project Manager:	J. Smith	**Launch Date:**	11/4/95
MOM:	G. Kazz	**Projected Spacecraft Life:**	3 yr goal
Project Responsibility:	JPL	**DSN Support:**	
Sponsor:	NASA	**Source:**	N/A

1 Mission Description

The primary objective of the SURFSAT-1 mission is to characterize the Earth’s atmospheric effects for Ka-band (32 GHz) versus X-band (8 GHz), as deep-space missions move toward using Ka-band telecommunications for enhanced data return. A secondary objective of SURFSAT-1 is to serve as a test vehicle at X-band and Ku-band (15 Ghz) for a new 11-m antenna subnet being implemented by the DSN in support of the U.S. Space Very Long Baseline Interferometry (SVLBI) Program.

2 Flight Profile

The SURFSAT-1 spacecraft was launched aboard a Delta II launch vehicle, simultaneously with the Canadian RADARSAT spacecraft, from Vandenberg Air Force Base. The SURFSAT-1 spacecraft, which consists of two boxes mounted directly on the Delta II second stage, was to be inserted into a 1200-km polar orbit. During the launch phase, in its first pass over Goldstone, DSS 17 tracked the S-band beacon aboard the Delta II second stage, while DSS 13 commanded the spacecraft on at X-band.

3 Coverage

The DSN will support the entire orbital mission and will negotiate to obtain additional support from space command during the early orbital phase, defined as 11/1/95, to 1/1/96.

3.1 Early Orbit Coverage Goals (11/1/95 to 1/1/96)

Primary coverage will be by space command (acquisition vectors) and DSS 13 (science and navigation data).

3.2 Prime Orbit Coverage Goals (1/1/96 to End of Mission)

Primary coverage will be by the DSN 11-m subnet for two-way coherent Doppler (navigational) data at X-band and Ku-band, and by DSS 13 for science data.

3.3 Network Support

The support provided by the DSN is indicated in the following table:

System	GDSCC		CDSCC	MDSCC
	13	23	33	53
Telemetry:				
X-band	P	P	P	P
Ku-band		P	P	P
Ka-band	P			
P = Prime				

4 Frequency Assignments

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)
X-band:		
Command	7.222 GHz	8.478 GHz
Tracking	7.222 GHz	8.478 GHz
Ku-band tracking	15.327 Ghz	14.148 Ghz
Ka-band tracking	N/A	32.028 GHz

Total Ozone Mapping Spectrometer-Earth Probe (TOMS-EP)

TMS Manager:	E.B. Luers	**Launch Vehicle:**	Pegasus-XL
NOPE:	J.C. Green	**Range:**	WR
Project Manager:	P. Sabelhaus	**Launch Date:**	7/1/96
DSOPM:	B. Thoman (GSFC)	**Projected Spacecraft Life:**	3 yr
Project Responsibility:	GSFC	**DSN Support:**	2 yr
Sponsor:	NASA	**Source:**	DMR

1 Mission Description

The primary science objectives of the TOMS-EP mission are to supplement and continue the ongoing measurements of the Earth's atmospheric ozone currently being performed by the USSR-US Meteor-3/TOMS cooperative mission.

2 Flight Profile

TOMS-EP was launched on a Pegasus-XL expendable launch vehicle from Vandenberg Air Force Base, Western range (WR). The final orbit will be a 955-km (-synchronous orbit with an Equator crossing between 1100 and 1200 local mean time.

3 Coverage

3.1 Coverage Goals

The DSN will support four to 6 8- to 12- min contacts per day (nominally 4 to 6 h apart). The DSN will provide maximum coverage for launch and early orbit support.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry				P	B				P			P
Command				P	B				P			P
Tracking				P	B				P			P
B = Backup, P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2273.500	RCP
Command	2093.510	N/A	RCP
Tracking	N/A	2273.500	RCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM (NRZ-M)/PSK/PM
Subcarrier	1.024 MHz (sine wave)
Bit rates	R/T, 1.125 kb/s; P/B, 50.625 kb/s or 202.5 kb/s
Coding	N/A
Recording	Digital

5.2 Command

Format	PCM (NRZ-L)/PSK/PM
Bit rate	2.0 kb/s
Subcarrier frequency	16 kHz (sine wave)
Recording	Digital

5.3 Support

Uplink power	2.0 kW nominal
Antenna:	
Rate	High
Angle data	Required
Autotrack	Yes
Doppler rates	High
Range format	Tone
Recording	Digital

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	DSN and WFF
Mission	DSN and WFF
Emergency	DSN and WFF

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Tracking and Data Relay Satellite System (TDRSS)
TDRS-1, -3, -4, -5, -6, -7

TMS Manager:	E.B. Luers	**Launch Vehicle:**	STS-IUS
NOPE:	J.C. Green	**Range:**	ETR
Project Manager:	A.B. Comberiate (GSFC)	**Launch Date:**	4/4/83; 9/29/88; 3/13/89; 8/2/91; 1/13/93; 6/8/95
DSOPM:	R. Miller	**Projected Spacecraft Life:**	10 yr
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	NASA	**Source:**	SIRD (1/91)

1 Mission Description

TDRSS consists of multiple satellites in geosynchronous orbits and a dedicated ground station.

The payload of each TDRS is a telecommunications service system that relays communication signals between low Earth-orbiting user spacecraft and the TDRSS ground terminal. This relay is accomplished by two types of communications links: (1) a multiple-access system, with one 30-element S-band phased-array antenna system; and (2) a single-access system, either S-band single-access or K-band single-access, with two 4.8-meter parabolic antennas, each operating at both S-band and K-band.

2 Flight Profile

Each TDRS was placed into a geostationary orbit with an altitude of 35,800 km. At apogee, the satellites will arrive at 56, 79, 102, or 94° west longitude corresponding to deployment and transfer from the Shuttle orbits of 8th descending, 9th descending, 10th descending, or 18th ascending nodes, respectively. From one of these initial locations, each TDRS will drift to its operational position. Each spacecraft will have an inclination of 0°. The in-orbit spare will be located between 55° and 70° West longitude at a 0°inclination to minimize the time needed to reach either geosynchronous station.

3 Coverage

3.1 Coverage Goals

The DSN is responsible for supporting launch and transfer orbits and providing emergency support from GDSCC and MDSCC. The 26-m or 34-m antenna will provide the emergency support. Follow-on launch and transfer orbit support will be required for replacement launches from all three complexes.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC				CDSCC				MDSCC		
	12	14	15	16	42	43	45	46	61	63	66
Telemetry	B			P	B			P	B		P
Command	B			P	B			P	B		P
Tracking	B			P	B			P	B		P
B = Backup, P = Prime											

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2211.5/2206.5	RCP
Command	2035.96	N/A	RCP
Tracking	2035.96	2211.5	RCP

5 Support Parameters

5.1 Telemetry

Data streams 1

Format PCM(NRZ-L)/PSK/PM

Subcarrier frequency 1.024 MHz (sine wave)

Bit rate 250, 1000, or 4000 b/s

Recording Digital

5.2 Command

Format PCM (NRZ-L)/PSK/PM

Bit rate 2000 b/s

Subcarrier frequency 16 kHz (sine wave)

Recording Digital

5.3 Support

Uplink power	2 kW or 16 kW
Antenna:	
Rate	Nil
Angle data	Not required
Autotrack	Yes
Doppler Rate	Nil
Range format:	
Prime	Tone
Backup	DSN standard
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
STS launch	GSFC
Mission	WSGT
Emergency	DSN

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Tracking and Data Relay Satellite System (TDRSS)
TDRS-H, -I, -J

TMS Manager:	E.B. Luers	**Launch Vehicle:**	Atlas II
NOPE:	J.C. Green	**Range:**	ETR
Project Manager:	A.B. Comberiate (GSFC)	**Launch Date:**	7/99; 7/02; 7/03
DSOPM:	R. Miller (GSFC)	**Projected Spacecraft Life:**	11 yr
Project Responsibility:	GSFC	**DSN Support:**	11 yr
Sponsor:	NASA	**Source:**	DMR (Draft)

1 Mission Description

TDRSS consists of multiple satellites in geosynchronous orbits and a dedicated ground station. The payload of each TDRS is a telecommunications service system that relays communication signals between low Earth-orbiting user spacecraft and the TDRSS ground terminal.

2 Flight Profile

Each spacecraft will be launched by an Atlas IIA with a Centaur upper stage from the Eastern Range. The launch will place the spacecraft into a transfer orbit of 222 km by 24,078 km with an inclination of 27°. Over the next several weeks the orbit will be adjusted to a geosynchronous orbit of 35,800 km altitude with an inclination of 7°.

3 Coverage

3.1 Coverage Goals

The DSN will support the prelaunch compatibility test, data interface verification testing, and launch rehearsals. The DSN will support launch through spacecraft checkout, and will provide emergency support for the life of the mission.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC						CDSCC				MDSCC			
	14	**15**	**16**	**17**	**24**	**27**	**34**	**43**	**45**	**46**	**54**	**63**	**65**	**66**
Telemetry			P	B	B	B	B			P	B			P
Command			P	B	B	B	B			P	B			P
Tracking			P	B	B	B	B			P	B			P
B = Backup, P = Prime														

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2211.50	RHC
Command	2035.9625	N/A	RHC
Tracking	2035.9635	2211.50	RHC

5 Support Parameters

5.1 Telemetry

Data streams	2
Format	PCM(NRZ-L)/BPSK/PM (clear mode) PCM(NRZ-M)/BPSK/PM (secure mode)
Subcarrier frequency	1.024 MHz (sine wave)
Bit rates	500, 1000, 4000 b/s
Coding	None
Recording	Digital

5.2 Command

Format:	
Clear mode	PCM(NRZ-L)/BPSK/PM
Secure mode	PCM(NRZ-M)/BPSK/PM
Bit rate	2 kb/s
Subcarrier frequency	16 kHz (sine wave)
Recording	Digital

5.3 Support

Uplink power	2 kW
Antenna:	
Rate	High
Angle data	Required
Autotrack	Required
Doppler rate	High
Range format	Tone
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	GSFC/DSN
Early orbit	GSFC/DSN
Mission	GSFC
Emergency	GSFC/DSN

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Transition Region and Coronal Explorer (TRACE)

TMS Manager:	E.B. Luers	**Launch Vehicle:**	Pegasus-XL
NOPE:	L. Weinberg	**Range:**	
Project Manager:	T. Gehringer (GSFC)	**Launch Date:**	3/98
DSOPM:	J. Catena (GSFC)	**Projected Spacecraft Life:**	1 yr
Project Responsibility:	GSFC	**DSN Support:**	1 yr
Sponsor:	NASA	**Source:**	MRR (Draft)

1 Mission Description

TBD

2 Flight Profile

The spacecraft will be launched into a nominal 523-km Sun-synchronous near-polar orbit by a Pegasus-XL expendable launch vehicle from the TBD range. The satellite will orbit the Earth every TBD minutes, crossing the equator at 10:30 a.m. local time,

3 Coverage

3.1 Coverage Goals

The DSN will provide launch and early orbit support, approximately 30 d, using the GDSCC 9-m antenna and the 26-m subnet. Emergency support will be provided by the DSN during the life of the mission.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				P	B				P			P
Command				P	B				P			P
Tracking				P	B				P			P
B = Backup, P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2275.3	TBD
Command	2095.172	N/A	TBD
Tracking	N/A	2275.3	TBD

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM(TBD)/PSK/PM
Subcarrier frequency	1.024 MHz (sine wave)
Bit rates	23.4375 kb/s on subcarrier 1.125 and 2.25 Mb/s on carrier
Coding	Convolutional K=7, R=1/2
Recording	Digital

5.2 Command

Format	PCM/(NRZ-M)PSK/PM
Subcarrier frequency	16 kHz (sine wave)
Bit rate	2 kb/s
Recording	Digital

5.3 Support Systems

Uplink power	2 kW
Antenna:	
Rate	High
Angle data	Required
Autotrack	Required
Doppler rates	High
Range format	Tone
Recording	Digital

6 *Tracking Support Responsibility*

The assigned responsibility for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	WFF
Early orbit	WFF/DSN
Mission	WFF
Emergency	WFF/DSN

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Tropical Rainfall Measuring Mission (TRMM) (Emergency Support)

TMS Manager:	E.B. Luers	**Launch Vehicle:**	H-II
NOPE:	J.C. Green	**Range:**	Japan
Project Manager:	T. LaVigna (GSFC)	**Launch Date:**	11/27/97
DSOPM:	K. Schauer (GSFC)	**Projected Spacecraft Life:**	3 yr
Project Responsibility:	GSFC	**DSN Support:**	Life of mission
Sponsor:	NASA	**Source:**	DMR

1 Mission Description

TRMM is an integral part of the NASA mission to Planet Earth Program under the Earth Probe series of research satellites. The purpose of TRMM is to study the distribution and variability of precipitation and latent heat release over a multi-year data set. TRMM is a climate mission designed to determine the rate of rainfall and the total rainfall between the North and South latitudes of 35°. The primary climate data set is the monthly average rainfall with a spatial resolution of 500 km.

2 Flight Profile

TRMM was launched from Tanegashima, Japan on an H-II expendable launch vehicle. The H-II placed TRMM into a low-altitude (380-km) orbit. The time it took the orbit to decay and be maneuvered to its operational altitude (350 km) was approximately 1 month. This period was used by the project for observatory system checkout.

Orbit: Circular; 350 km; 35° inclination.

3 Coverage

3.1 Coverage Goals

DSN coverage for the TRMM will be provided during emergencies that would prevent communications via the normal TDRSS-White Sands link. Emergency support will be provided by the DSN's 26-m antenna subnetwork.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				E	E				E			E
Command				E	E				E			E
Tracking				E	E				E			E
E = Emergency support												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2255.5	RCP
Command	2076.94	N/A	RCP
Tracking	2076.94	2255.5	RCP

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM(NRZ-L)/biphase-l/PM PCM/PM
Subcarrier frequency	N/A
Bit rates	1.024, 32.768 kb/s
Coding:	Convolutional (R=1/2, K=7) with Reed-Solomon (255,223) interleave depth of 5
Recording	Digital

5.2 Command

Format	PCM(NRZ-L)PSK/PM
Subcarrier frequency	16 kHz (sine wave)
Bit rate	2 kb/s
Recording	Digital

5.3 Support

Uplink power	2 kW
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes
Doppler rates	Moderate
Range format	Tone
Recording	Digital

6 Tracking Support Responsibility

The assigned responsibility for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	GSFC
Early orbit	GSFC/DSN
Mission	GSFC
Emergency	DSN

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Ulysses

TMS Manager:	D.M. Enari	**Launch Vehicle:**	STS-IUS-PAM-S
NOPE:	A.G. Knight	**Range:**	ETR
Project Manager:	E. Massey	**Launch Date:**	10/6/90
MOM:	P. Beech (ESOC)	**Projected Spacecraft Life:**	8 yr
Project Responsibility:	JPL/ESA	**DSN Support:**	8 yr
Sponsor:	ESA/NASA	**Source:**	SIRD (12/83)

1 Mission Description

The primary objectives of Ulysses are to extend scientific knowledge and understanding through exploration of the Sun and its environment, and to investigate possible mechanisms coupling solar variability to terrestrial weather and climate by studying the Sun's structure and emission as a function of latitude from the solar equator to the solar poles.

2 Flight Profile

Ulysses consists of a single European Space Agency (ESA) spacecraft. The spacecraft was launched in 1990 from Kennedy Space Center (KSC) by a space transportation system (STS) vehicle using an inertial upper stage (IUS) and a Propulsion Assist Module (PAM-S) to inject the spacecraft into an interplanetary orbit toward Jupiter. After Jupiter flyby, the spacecraft travels in a heliocentric, out-of-ecliptic orbit with high heliographic inclination. The mission terminates in September 1995 at the end of the second polar pass. The highest priority portion of the mission occurs when the spacecraft is greater than 70° heliographic latitude during solar passes.

3 Coverage

3.1 Coverage Goals

The antenna coverage profile provided in the following table, supports document JPL D-292, *Ulysses Support Instrumentation Requirements Document (SIRD)*, dated 4/24/89. There have not been any additions or deletions to the SIRD since launch, October 1990. The requirements are expected to increase only when the project cannot obtain minimal support to retrieve data from its on-board tape recorder to complete daily 24-h coverage throughout the prime mission phase.

The DSN expects to meet the coverage goals except when other spacecraft emergencies occur or in the case of other interruptions which are beyond the control of the DSN.

Mission Phase	Period	Passes/ Month (30 d)	Antenna
Launch	10/5/90 to 10/ 23/90	6	26-m
TCMs, spacecraft checkout, science turn-on, calibrations		90 8	34-m STD 70-m
DOR during overlaps only	L + 41 to L + 50	27	34-m HEF
Routine	12/90	30	34-m STD
First opposition (70-m: last week of December, first week of January)	12/90 to 1/91	27	70-m
Routine	1/91 to 5/91	30	34-m STD
First conjunction	6/91 to 11/91 6/91 7/91 8/91 9/91	30 30 30 45 30	34-m STD 34-m HEF 70-m 70-m 70-m
Routine	12/91 to 1/92	30	34-m STD
Jupiter flyby	2/92 2/92	90 30	34-m STD 70-m
Second opposition	3/92	90	34-m STD
Gravitational wave experiment	3/92	90	34-m HEF
Routine	4/92 to 5/92	30	34-m STD
Second conjunction	6/91 to 8/92 6/92 to 8/92 9/92 10/92 to 11/92 10/92 to 11/92	13 17 30 13 17	34-m STD 70-m 70-m 34-m STD 70-m
Routine	12/92 to 2/93 (to mid-Feb)	30	34-m STD
Third opposition	2/93 to 3/93	90	34-m STD
Gravitational wave experiment	(From mid-Feb) 2/93 to 3/93	90	34-m HEF
Routine	4/93 to 5/94	30	34-m STD
Solar pass 1	6/94 to 7/94	30	34-m STD

(table continued)

Mission Phase	Period	Passes/ Month (30 d)	Antenna
Nutation pass	8/94 to 2/95	90	34-m STD/70-m
Routine	3/95	30	34-m STD
Nutation period	4/95 to 9/95		34-m STD/70-m
Solar pass 2	6/95 to 9/95	30	34-m STD
EOM	10/95		

3.2 *Network Support*

The support provided by the DSN during cruise is indicated in the following table:

System	GDSCC				CDSCC				MDSCC			
	12	**14**	**15**	**16**	**42**	**43**	**45**	**46**	**61**	**63**	**65**	**66**
S-band:												
Telemetry	P	P		*	P	P		*	P	P		*
Command	P	P		*	P	P		*	P	P		*
Tracking	P	P		*	P	P		*	P	P		*
X-band:												
Telemetry	P	P	P		P	P	P		P	P	P	
Tracking	P	P			P	P			P	P	P	

P = Prime
* 26-m S-band support for initial acquisition or backup.

During the first solar pass (5/94 to 10/94) and the second solar pass (5/95 to 9/95), the spacecraft will be in nearly continuous view of the southern hemisphere station, and then it will be in nearly continuous view of the northern hemisphere station.

The coverage to be provided during critical events is listed in the following table:

System	GDSCC				CDSCC				MDSCC			
	12	14	15	16	42	43	45	46	61	63	65	66
S-band:												
Telemetry	P	P	P		P	P	P		P	P	P	
Command	P	P			P	P			P	P		
Tracking	P	P			P	P			P	P		
X-band:												
Telemetry	P	P	P		P	P	P		P	P	P	
Tracking	P	P			P	P			P	P	P	
P = Prime												

3.3 *Compatibility Testing*

MIL 71 and the compatibility test van will support compatibility and other project retests beginning in April 1990.

4 *Frequency Assignments*

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)	Polarization
S-band:			
Telemetry	N/A	2293.148148	RCP
Command	2111.607253	N/A	RCP
Tracking	2111.607253	2293.148148	RCP
X-band:			
Telemetry	N/A	8408.209876	RCP
Tracking	N/A	8408.209876	RCP

5 *Support Parameters*

5.1 *Telemetry*

Data streams	1 (S-band or X-band)
Format	PCM(NRZ-L)/PSK/PM
Subcarrier frequency	65.536 kHz for 64, 128, 256,
Bit rates	512, 1024, 2048, 4096, 8192 b/s; 131.072 kHz for 2048 to 8192 b/s
Recording	DODR required

5.2 Command

Format	PCM/PSK/PM
Bit rate	15.6250 b/s
Subcarrier frequency	16 kHz

5.3 Support

Uplink power	Up to 20 kW (34-m), 100 kW (70-m)
Antenna:	
Rate	Sidereal, except at launch
Angle data	Not required
Autotrack	First pass (26-m only)
Doppler rates	Moderate, except first pass
Range format	Standard DSN
Recording:	
Analog	Not required
Digital	Required

6 Tracking Support Responsibility

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
STS launch	TDRSS
IUS/PAM-S injection	TDRSS/USAF
Cruise/encounter/solar passes	DSN

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Upper Atmosphere Research Satellite (UARS) (Emergency Support)

TMS Manager:	E.B. Luers	**Launch Vehicle:**	STS
NOPE:	J.C. Green	**Range:**	ETR
Project Manager:	E. Macie (GSFC)	**Launch Date:**	9/26/91
Operations Manager:	G. Wade (GSFC)	**Projected Spacecraft Life:**	7 yr
Project Responsibility:	GSFC	**DSN Support:**	Life of the mission
Sponsor:	NASA	**Source:**	SIRD (6/83)

1 Mission Description

The UARS project is designed to study the Earth's middle and upper atmosphere.

2 Flight Profile

The UARS satellite was launched from the ETR in 1991 via the STS (Shuttle). It was placed directly into a circular orbit of 600 km x 600 km x 57° with a period equal to 97 min.

3 Coverage

3.1 Coverage Goals

Coverage will be provided by the DSN for UARS emergencies that would prevent communications via the normal channel of TDRSS to White Sands. Emergency support would be provided by the DSN 26-meter subnetwork of stations.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry			E	E					E			E
Command			E	E					E			E
Tracking			E	E					E			E
E = Emergency support												

4 *Frequency Assignments*

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2287.5	RHC
Command	2106.4	N/A	RHC
Tracking	2106.4	2287.5	RHC

5 *Support Parameters*

5.1 *Telemetry*

Data streams	2
Format	PCM (biphase-s)/PM or PCM (biphase-s)/PSK/PM
Subcarrier frequency	1.524 MHz (sine wave)
Bit rates	1 kb/s, 32 kb/s, or 512 kb/s
Coding	None
Recording	Digital

5.2 *Command*

Format	PCM(NRZ-L)PSK/PM
Bit rate	1 kb/s, 0.125 kb/s
Subcarrier frequency	16 kHz (sine wave)
Recording	Digital

5.3 *Support*

Uplink power	2 kW
Antenna:	
Rate	Moderate
Angle data	Required
Autotrack	Yes
Doppler rates	Moderate
Range format	Tone
Recording	Digital

U.S. Space Very Long Baseline Interferometry (SVLBI) (Cooperative)

TMS Manager:	A. Berman	**Launch Vehicle:**	N/A
NOPE:	A. Short	**Range:**	N/A
Project Manager:	J. Smith	**Launch Date:**	VSOP: 2/7/97; RadioAstron: 1997/1998
MOM:	J. Ulvestad	**Projected Spacecraft Life:**	5 yr
Project Responsibility:	JPL/ISAS/ASC	**DSN Support:**	5 yr
Sponsor:	NASA/ISAS/ASC	**Source:**	MRR (11/92)

1 Description

1.1 Project

SVLBI is a cooperative mission between NASA, ISAS, and ASC. ISAS provides the VSOP spacecraft and Japanese tracking stations, ASC provides the RadioAstron spacecraft and Russian tracking stations, and NASA provides the four-station SVLBI subnet.

The two space VLBI missions, VSOP and RadioAstron, will each place into high Earth orbit a spacecraft that carries a radio telescope. Each telescope will observe astronomical radio sources simultaneously with ground radio telescopes and extend the techniques of VLBI arrays. This array will produce images of the observed radio sources with greatly increased resolution over what can be achieved with ground telescopes alone, as a result of the longer baselines achieved with spaceborne antennas.

1.2 Mission

VSOP will place an 8-m telescope and radio astronomy receivers in high Earth orbit, and Radio-Astron will do the same, but with a 10-m telescope. Each antenna will receive in three standard astronomy bands (1.6 GHz, 5 GHz, and 22 GHz), providing broad frequency coverage of galactic and extragalactic continuum sources, as well as observations of two important maser lines (OH at 1.6 GHz and H₂O at 22 GHz). RadioAstron will also operate at 0.3 GHz to allow studies of pulsars and interstellar scattering and refraction. The space systems will consist of antenna, receivers, data system, equipment for the radio link to Earth, and a carrier bus to provide pointing, power, and thermal control. The stable frequency reference required on the satellites will be sent to the spacecraft from a ground-based hydrogen maser frequency standard via a radio link. The radio link will also carry the digitized astronomical signal to the ground, where it will be recorded on tapes that will be shipped to a VLBI correlator and cross-correlated with tapes recorded at ground-based radio telescopes.

The fundamental difference between the two missions is the spacecraft orbit. The VSOP orbit, the smaller of the two, will have an apogee altitude of about 22,000 km. This orbit will provide a threefold increase in angular resolution over ground-based telescope arrays, while at the same time providing fairly uniform coverage of the aperture plane when used in conjunction with appropriate ground arrays. Thus VSOP is a powerful *imaging* instrument with an angular resolution of 55 microseconds of arc at 22 GHz. The RadioAstron orbit will have an apogee altitude of 77,000 km, chosen to increase the angular resolution further to about 25 ms of arc at 22 GHz, but at the expense of image quality, since the aperture plane coverage will be significantly poorer due to aperture holes introduced by the selected orbit. Thus RadioAstron is an exploratory instrument with unprecedented angular resolution that can achieve fundamental new discoveries.

Both missions will study energetic events in the universe: the origin, structure, and evolution of active galactic nuclei and the birth and death of stars. The VSOP mission will focus on the mapping and monitoring of quasars and active galactic nuclei at much higher resolution than is possible with ground telescopes alone, and it will provide greatly improved mapping of Southern Hemisphere radio sources. The RadioAstron mission will focus on searching for sources of high brightness temperature by surveying a large sample of bright compact sources. Both missions plan on a 3-to-6-month in-orbit checkout before starting scientific observations. Both mission design lifetimes are 3 years with a possible extension to 5 yr.

2 Flight Profile

ISAS plans to launch the VSOP spacecraft into Earth orbit with Japan's new M-V launch vehicle is September 1996. The RadioAstron spacecraft will be launched into Earth orbit by a Proton rocket. Although the launch date for RadioAstron currently is uncertain, NASA believes it is likely to be in late 1997 or 1998. The VSOP orbit is planned to be 22,000 km by 1,000 km at an inclination of 31° with a period of 6.6 h. The RadioAstron orbit is planned to be 77,000 km by 4,000 km at an inclination of 51° with a period of 28 h.

3 Coverage

3.1 Coverage Goals

Coverage is provided by the SVLBI Subnet, which includes the DSN 3-station 11-m subnet, and the 14-m NZAO Green Bank station in Green Bank, West Virginia. Coverage by the SVLBI Subnet for both VSOP and RadioAstron will be between 12 and 20 h daily. At the present time, there are no other SVLBI Subnet users, so no conflicts in support are anticipated.

3.2 Network Support

The support to be provided by the SVLBI subnet is indicated in the following table:

System	GDSCC	CDSCC	MDSCC	NZAO Green Bank
	23	33	53	14
X-band:				
Telemetry	P	P	P	P
Tracking	P	P	P	P
Ku-band:				
Telemetry	P	P	P	P
Tracking	P	P	P	P
Tracking				
P = Prime				

4 Frequency Assignments

Frequencies are assigned according to the following table:

System	Uplink (GHz)	Downlink (GHz)
VSOP:		
Telemetry		14.2
Tracking	15.3	14.2
RadioAstron:		
Telemetry		15.06304
Tracking	7.215255	8.472960

5 Support Parameters

5.1 VSOP

Frequency	14.2 GHz
Subcarrier	None
Modulation	Balanced QPSK
Data rate	128 Mb/s
Encoding	None
Frame size	80 kB (640 kb)
Frame sync word	4 B (32 b)

5.2 RadioAstron

Frequency	15.06304
Modulation	Balanced QPSK
Data rates	144, 72, 36 Mb/s (18, 36, and 72 in each of I and Q)
Encoding	1 parity bit per 8-bit data byte
Frame size	20 kB (160 kb, not including parity bit)
Frame sync word	7 bytes (56 b, not including parity bit)

6 Tracking Support Responsibility

The assigned responsibility for tracking support is listed in the following table:

Mission Phase	Responsibility	
	VSOP	RadioAstron
Launch	ISAS/DSN	ASC
In-orbit checkout	ISAS/DSN	ASC/DSN
Prime mission	ISAS/DSN	ASC/DSN

Voyager Interstellar Mission (VIM)

TMS Manager:	A.I. Beers	**Launch Vehicle:**	N/A
NOPE:	E.A. Batka	**Range:**	N/A
Project Manager:	G. Textor	**Launch Date:**	Voyager 1: 9/5/77; Voyager 2: 8/20/77
Mission Director:	R. Rudd	**Projected Spacecraft Life:**	2019
Project Responsibility:	JPL	**DSN Support:**	N/A
Sponsor:	NASA	**Source:**	SIRD (2/90)

1 Mission Description

The continuation of the Voyager project beyond the outer planets is called the Voyager Interstellar Mission and utilizes both Voyager spacecraft for the period from 1/190 through 12/31/19.

2 Flight Profile

The VIM objectives will be accomplished by extending operation of both Voyager 1 and Voyager 2 throughout the approved mission period.

The general mission objectives of the VIM are:

- To investigate the interplanetary and interstellar media, and to characterize the interaction between the two.
- To continue the successful Voyager program of ultraviolet astronomy.

3 Coverage

3.1 Coverage Goals

The project requires a minimum of 16 h/d of tracking coverage for each spacecraft in order to obtain science telemetry data. The total station ground aperture coverage requirements are provided in the following table. The table lists both the 34-m and 70-m spacecrafts When the heliopause is reached (possibly in 2010), continued 70-m coverage of both spacecraft is required for the duration of the investigation.

Mandatory Aperture Function	**34-m STD[a]**	**34-m HEF[a]**	**70-m**	**34/70 Array**	**Enhancement 34-m STD[b]**	**Enhancement 34-m HEF[b]**	**Enhancement 70-m**	**Enhancement 34/70 Array**
Telemetry, Doppler ranging, command, Voyager 2 BLF	3	0	1.3	0	1	0	1	0
Telemetry only	7	10	1	4 yr	1	2	0	1 yr

[a] 70-m passes may be substituted.
[b] Assumes 10 h/pass, exclusive of prepass and postpass calibrations.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System	GDSCC			CDSCC			MDSCC		
	12	14	15	42	43	45	61	63	65
S-band:									
Telemetry	P	P	P	P	P	P	P	P	P
Command	P	P		P	P		P	P	
Tracking	P	P		P	P		P	P	
X-band:									
Telemetry	P	P	P	P	P	P	P	P	P
Tracking	P	P		P	P		P	P	
P = Prime (DSSs 12, 42, and 61 tracking data are Doppler only. (No ranging.)									

4 Frequency Assignments

Frequencies are assigned according to the following table:

System	Uplink (MHz)	Downlink (MHz)	Polarization
Voyager 1:			
S-band:			
Telemetry		2296.481481	RCP
Command	2114.676697		RCP
Tracking	2114.676697	2296.481481	RCP
X-band:			
Telemetry		8420.432097	LCP
Tracking		8420.432097	LCP
Voyager 2:			
S-band:			
Telemetry		2295.000000	RCP
Command	2113.312500		RCP
Tracking	2113.312500		RCP
X-band:			
Telemetry		8415.000000	RCP
Tracking		8415.000000	RCP

5 Support Parameters

5.1 Telemetry

Data streams:	
Voyager 1	1 X-band, continuous and 1 S-band, selected periods
Voyager 2	1 X-band, continuous and 1 S-band, selected periods
Format	PCM(NRZ-L)/PSK/PM
Subcarrier frequency	22.5, 360 kHz
Bit rates	40 b/s, 46 b/s, 6 b/s, 80 b/s, 160 b/s, 600 b/s, 1200 b/s, 1400 b/s, 2800 b/s, 3600 b/s, 4800 b/s, 7200 b/s
Recording	Dual telemetry ODRs required for critical passes; single ODRs otherwise
Coding	Convolutional (K=7, R=1/2)

5.2 Command

Format	PCM (Manchester encoded)/ PSK/PM
Bit rate	16 b/s
Subcarrier frequency	512 Hz

5.3 Support

Uplink power	20 to 400 kW (400 kW for emergencies)
Antenna:	
Rate	Sidereal
Angle data	Not required
Autotrack	Not required
Doppler rates	Moderate
Range format	Standard DSN
Recording:	
Analog	Not required
Digital	Required

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	**Support Responsibility**
Interstellar	DSN

Wide-Field Infrared Explorer (WIRE)

TMS Manager:	E.B. Luers	**Launch Vehicle:**	Pegasus-XL
NOPE:	L. Weinberg	**Range:**	WR
Project Manager:	J. Watzin (GSFC)	**Launch Date:**	9/15/98
DSOPM:	J. Catena	**Projected Spacecraft Life:**	4 mo
Project Responsibility:	GSFC	**DSN Support:**	4 mo
Sponsor:	NASA	**Source:**	MRR (Draft)

1 Mission Description

WIRE uses a single cryogenically cooled infrared telescope to survey more than 100 square degrees of the sky (selected target areas) in two infrared bands. The objectives of the science investigation are to: determine what fraction of the luminosity of the universe, at red shifts of 0.5 and greater, is due to starburst galaxies; determine how starburst galaxies are evolving; and determine whether luminous protogalaxies are common at red shifts of less than 3.

2 Flight Profile

The spacecraft will be launched into a nominal 400-km Sun-synchronous near-polar orbit by a Pegasus XL from the Western range.

3 Coverage

3.1 Coverage Goals

The DSN will provide mission support using the GDSCC 9-m antenna and the 26-m subnet.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	GDSCC					CDSCC				MDSCC		
	12	14	15	16	17	42	43	45	46	61	63	66
Telemetry				P	B				P			P
Command				P	B				P			P
Tracking				P	B				P			P
B = Backup, P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2215.00	RHC
Command	2019.64	N/A	RHC
Tracking	N/A	2215.00	RHC

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM(NRZ-L)/PM
Subcarrier frequency	NA
Bit rates	23.44 kb/s, 1.125 Mb/s, or 2.25 Mb/s
Coding	Convolutional (K=7, R=1/2)
Recording	Digital

5.2 Command

Format	PCM/(NRZ-L)PSK/PM
Subcarrier frequency	16 kHz (sine wave)
Bit rate	2000 b/s
Recording	Digital

5.3 Support

Uplink power	2 kW
Antenna:	
Rate	High
Angle data	Required
Autotrack	Required
Doppler rates	High
Range format	Tone
Recording	Digital

6 *Tracking Support Responsibility*

The assigned responsibility for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Launch	TBD
Mission	WFF/DSN
Emergency	WFF/DSN

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YOHKOH (SOLAR-A)

TMS Manager:	A.F. Chang	**Launch Vehicle:**	N/A
NOPE:	S. Waldherr	**Range:**	N/A
Project Manager:	Y. Ogawara (ISAS)	**Launch Date:**	8/29/91
MOM:	K. Ninomiya (ISAS)	**Projected Spacecraft Life:**	10 yr
Project Responsibility:	ISAS	**DSN Support:**	10 yr
Sponsor:	ISAS	**Source:**	SIRD (2/91)

1 Mission Description

The YOHKOH spacecraft mission objectives are to investigate high-energy phenomena of the Sun using X-ray telescopes and spectrometers during the maximum activity period of the solar cycle. Experiments are being supported by various universities and laboratories in Japan, England, and the United States.

2 Flight Profile

The spacecraft was launched from Kagoshima Space Center (KSC) in Uchinoura, Kagoshima Prefecture, Japan into a circular Earth orbit of approximately 500-km altitude and 31° inclination by an M3SII launch vehicle, resulting in a 97-min orbit period.

3 Coverage

No DSN launch vehicle support was required. The DSN supports the Mission phase only.

3.1 Coverage Goals

The DSN records downlink telemetry and transmits the data within 48 h to ISAS. The project requirement is to support 10 contacts with the spacecraft per day during the first year of the prime mission. Support requirements will be assessed on a yearly basis after the first year. Station view periods are 7 to 10 min. Unless the spacecraft has an anomaly, DSN support consists of a 5.5-min bubble memory dump at 262,144 b/s, uncoded.

3.2 Network Support

The support provided by the DSN is indicated in the following table:

System (S-Band)	**GDSCC**					**CDSCC**				**MDSCC**		
	12	**14**	**15**	**16**	**17**	**42**	**43**	**45**	**46**	**61**	**63**	**66**
Telemetry				P	B				P			P
Command												
Tracking												
B = Backup, P = Prime												

4 Frequency Assignments

Frequencies are assigned according to the following table:

System (S-Band)	Uplink (MHz)	Downlink (MHz)	Polarization
Telemetry	N/A	2256.22	RCP
Command	N/A	N/A	N/A
Tracking	N/A	N/A	N/A

5 Support Parameters

5.1 Telemetry

Data streams	1
Format	PCM(NRZ-S)biphase/PM
Subcarrier frequency	
Bit rates	262144 b/s uncoded
Coding	Convolutional (K=7, R=1/2)
Recording	Required

5.2 Command

Not required.

5.3 Support

Uplink power N/A

Antenna:
- Rate: Moderate
- Angle data: Required
- Autotrack: Yes (26-m only)

Doppler rates Modest

Range format N/A

Recording:
- Analog: Required until 26-m integration is complete
- Digital: Required

6 *Tracking Support Responsibility*

The assigned responsibilities for tracking support is listed in the following table:

Mission Phase	Support Responsibility
Prelaunch	ISAS
Launch	ISAS
Mission	DSN, ISAS

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Appendix A
Acronyms and Abbreviations

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A

ACE	Advanced Composition Explorer
ACIS	AXAF-I charge-coupled device imaging spectrometer
ADEOS	Advanced Earth Observing Satellite
AKM	apogee kick motor
APL	Applied Physics Laboratory
ARC	Ames Research Center 111, 143
ASCA	Advanced Satellite for Cosmology and Astrophysics
ASF	Alaska SAR Facility
ASM	all sky monitor
AXAF	Advanced X-Ray Astrophysics Facility
AXAF-I	Advance X-Ray Astrophysics Facility-Imaging

B

BMFT	Bundesministerium für Forschung und Technologie

C

CCD	charge-coupled device
CDSCC	Canberra Deep Space Communications Complex
CEPT	Conference of Postal and Telecommunications Administrations
CEPT	European Conference of Postal and Telecommunications Administration
CNES	Centre National d’Etudes Spatiales
COMETS	Communications and Broadcasting Engineering Test Satellite
COSTR	Collaborative Solar Terrestrial Research
CSA	Canadian Space Agency
CTT	Compatibility Test Trailer

D

DLR	Deutsche Forschungsanstalt Für Luft-und-Raumfahrt
DMR	Detailed Mission Requirements
DSN	Deep Space Network
DTF 21	Development and Test Facility

E

ELV	expendable launch vehicle
EOM	end of mission

EOS	Earth Observing System
EPS	energetic particle sensor
ERBS	Earth Radiation Budget Satellite
ESA	European Space Agency
ESMC	Eastern Space and Missile Center
ETR	Easterm test range
EUTELSAT	European Telecommunications Satellite
EUV	extreme ultraviolet
EUVE	Extreme Ultraviolet Explorer

F

FAST	Fast Auroral Snapshot Explorer

G

GDS	ground data system
GDSCC	Goldstone Deep Space Communications Complex
GGS	Global Geospace Science
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning Satellite
GRO	Gamma Ray Observatory
GSFC	Goddard Space Flight Center
GSSR	Goldstone Solar System Radar
GWE	gravitational wave experiment

H

HEAO	high-energy astronomy observatory
HEF	high effeciency (antenna)
HEPAD	high-energy proton and alpha detector
HETGS	high-energy transmission grating spectrometer
HOP	Halo orbit phase
HRC	high-resolution camera
HRI	high-resolution X-ray Imager
HST	Hubble Space Telescope

I

ICV	intercenter vectors
IRAC	infrared array camera

ISAS	Institute of Space and Astronautical Science (Japan)
ISO	Infrared Space Observatory
ISTP	International Solar Terrestrial Physics
IUS	inertial upper stage

J

JOI	Jupiter orbit insertion
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center

K

kb	kilobit
kB	kilobyte
KSC	Kagoshima Space Center (Japan)
KSC	Kennedy Space Center

L

LEOP	launch and early orbit phase
LETGS	low-energy transmission grating spectrometer
LGA	low-gain antenna
LLV-1	Lockheed launch vehicle 1
LLV-2	Lockheed launch vehicle 2
LMA	Lockheed Martin Astronautics
Lunar-A	Lunar Penetrator Mission

M

MAP	Microwave Anisotropy Probe
MDSCC	Madrid Deep Space Communications Complex
MGA	medium gain antenna
MGSO	Multimission Ground Systems Office
MIPS	multi-band imaging photometer for SIRTF
MOI	Mars orbit insertion
MOM	mission operations manager
MOU	Memorandum of Understanding
MRR	Mission Requirements Request
MSL	Mars Surveyor 1998 Program: Lander
MSO	Mars Surveyor 1998 Program: Orbiter

MSS	multispectral scanner

N

NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency (Japan)
NEAR	Near-Earth Asteroid Rendezvous
NESDIS	National Environmental Satellite Data and Information Service
NMS	neutral mass spectrometer
NOAA	National Oceanic and Atmospheric Administration
NOPE	Network operations project engineer
NSCAT	NASA scatterometer
NSP	NASA Support Plan

O

OCTS	ocean color and temperature sensor
OSF	Office of Space Flight

P

PAM	Propulsion Assist Module
PCA	proportional counter array
PKM	perigee kick motor
POCC	Projects Operations Control Center
POD	Project operations director
PSPC	position-sensitive proportional counters

R

Rm	Mars radius
ROSAT	Roentgensatellit
RXTE	Rossi X-Ray Timing Explorer

S

SAR	search and rescue
SAR	synthetic-aperture radar
SELV	small expendable launch vehicle
SEM	space environment monitoring
SEP	solar electric propulsion
SIRD	Support Instrumentation Requirements Document

SIRTF	Space Infrared Telescope Facility
SOHO	Solar Heliospheric Observatory
SPD	Special Payloads Division
SPOT	Systeme Probatoire d'Observation de la Terre
SRA	sequential ranging assembly
SSTI	Small Spacecraft Technology Initiative
STD	standard
STRV	Space Technology Research Vehicle
STS	space transportation system
STSP	ESA Terrestrial Science Programme
STSP	Solar Terrestrial Science Programme
SURFSAT-1	Summer Undergraduate Research Fellowship Satellite Number 1
SV	space vehicles
SVLBI	Space Very Long Baseline Interferometry
SVM	service module
SWAS	Submillimeter Wave Astronomy Satellite

T

TBD	to be determined
TBS	to be supplied
TCM	trajectory correction maneuvers
TDA	Telecommunications and Data Acquisition
TDRSS	Tracking and Data Relay Satellite System
TLM	telemetry
TM	thematic mapper
TMS	Telecommunications and Mission Services
TOMS	Total Ozone Mapping Spectrometer
TOMS-EP	Total Ozone Mapping Spectrometer-Earth Probe
TOTS	Transportable Orbital Tracking Station
TRACE	Transition Region and Coronal Explorer
TRMM	Tropical Rainfall Measuring Mission
TSC	Tanegashima Space Center
TT&C	telemetry, tracking, and command
TTP	transfer trajectory phase

U

UARS	Upper Atmosphere Research Satellite
UDSC	Usuda Deep Space Center, Japan
UK	United Kingdom
UV	ultraviolet

V

VAFB	Vandenberg Air Force Base
VC	virtual channels
VEEGA	Venus Earth Earth Gravity Assist
VIM	Voyager Insterstellar Mission
VLBI	very long baseline interferometry

W

WFC	wide-field X-ray camera
WFF	Wallops Flight Facility
WIRE	Wide-Field Infrared Explorer
WOTS	Wallops Orbital Tracking Station
WR	Western range

X

XRI	X-ray imager
XRS	X-ray sensor

Appendix B
Definition of Terms

The following terms are listed in order of mission development.

Approved mission:	A mission established as having a new-start approval or having been appropriately obligated.
Reimbursable mission	A mission for which DSN support costs are reimbursed to NASA by varios users (e.g., U.S. private corporations, other foreign and domestic agencies.
Compatibility testing	Demonstration of compatibility of spacecraft systems with supporting network elements.
Launch and early orbit	(1) For geosynchronous missions, launch through the completion of AKM firing, with sufficient time to compute the resulting orbital parameters. (2) For nongeosynchronous missions, launch until orbital parameters have been computed, not to exceed 24 h.
Parking orbit	A preliminary orbit into which a spacecraft is injected prior to maneuvers placing the spacecraft into its mission orbit or intermediate orbit.
Transfer orbit	An intermediate orbit into which a spacecraft is placed prior to its final mission orbit. Generally, this orbit is to raise the spacecraft apogee.
Drift orbit	An orbit with an orbital period of slightly more or less than one sidereal day and which allows for a spacecraft longitudinal position to be changed.
Mission orbit	That orbit into which a spacecraft is placed for the purpose of meeting mission objectives.
Halo orbit	A special type of periodic orbit about an equilibrium point between two celestial bodies in a plane generally normal to the plane of the line of sight between the two bodies.
Geosynchronous/Geostationary satellite	A spacecraft in Earth orbit with a period of one sidereal day is considered geosynchronous. If its ecfentricity and inclination approach zero, the satellite is further defined as geostationary.
Sun-synchronous	A type of orbital condition, typically between 80° and 120° inclination, where the ascending node crosses the equator daily at a specified local solar time.
Backup support	A support readiness condition in which stations may be scheduled to assume mission support responsibilities should assigned primary support elements require augmentation or replacement.
Emergency support	Support provided to a mission as a result of a declared spacecraft emergency.

Appendix C
DSN Advanced Planning Mission Set

The following table is a compilation of potential future mission and is for information purposes only. mission titles, new start dates, and launch dates are projected only.

Mission	Projected		Description/Purpose
	New Start Date	Launch Date	
Muses-C	FY 96	1/02	This cooperative ISAS/NASA mission will consist of an ISAS SEP spacecraft and a JPL rover. The ISAS spacecraft is to collect a sample form the asteroid Nereus in the third quarter of 2003 and leave the JPL rover on the surface of the asteroid. The rover will initially communicate with Earth through a relay link on the ISAS spacecraft. DSN 34-m support is required during critical mission phases. Some DSN support may be required for a direct-to-Earth link with the rover after the ISAS spacecraft leaves the vicinity of Nereus.
Clementine II	FY 96	5/98	This NRL multiple near-Earth asteroid flyby mission would consist of a spacecraft with three penetrators, each of which would be launched into one of the three asteroid that the main spacecraft is to fly by. All flybys would be completed in a little over a year from launch. No MRR has been prepared, but it is anticipated that this mission will generally use 34-m stations and possibly a 70-m station during encounter. Most tracking would be through the DoD Pomonkey station. NRL has asked for DSN tracking equipment to be installed at Pomonkey.
Microwave Anisotropy Probe (MAP)	FY 96	9/00	MAP is an approved MIDEX mission at GSFC. The spacecraft will orbit the L2 libration point. The project requests either 13 min/d of tracking with a 70-m station or 85 min/d with 34-m station. The principle investigator has a strong preference for the 70-m coverage.
Pluto Express	FY 99	3/01	Two spacecraft will fly by Pluto in 2013, each recording data on an SSR and playing the data back over a period of several months to the DSN. Through most of the mission, 34-m antennas will be used. The 70-m antennas will be used during closest approach and possibly during the playback phase.
Solar Probe	FY 01	11/03	A JPL mission, Solar Probe is to get a gravity assist from Jupiter in 2005 and then make a close approach to the Sun in 2007.

Appendix D
Facility Identifiers

GDSCC:		
DSS 12	34-m S-/X-band antenna	Decommissioned 2/1/96
DSS 14	70-m S-/X-band antenna	
DSS 15	34-m S-/X-band high-efficiency antenna	
DSS 16	26-m S-band antenna	Operational 1/67
DSS 17	9-m S-band antenna	
DSS 23	11-m X-/Ku-band OVLBI antenna	Operational 9/26/97
DSS 24	34-m S-/X-band beam waveguide antenna	Operation 2/95
DSS 25	34-m X-band beam waveguide antenna	Operational 8/1/96
DSS 26	34-m X-band beam waveguide antenna	Operational 8/1/96
DSS 27	34-m S-band high-speed BWG antenna	Operational 7/95
DSS 28	34-m X-band high-speed BWG antenna	Operational 10/00
CDSCC:		
DSS 33	11-m X-/Ku-band OVLBI antenna	Operational 6/7/96
DSS 34	34-m S-/X-band beam waveguide antenna	Operational 11/1/96
DSS 42	34-m S-/X-band antenna	Decommission 12/1/98
DSS 43	70-m S-/X-band antenna	Operational 9/87
DSS 45	34-m S-/X-band high-efficiency antenna	
DSS 46	26-m S-band antenna	Operational 12/83
MDSCC:		
DSS 53	11-m X-/Ku-band OVLBI antenna	Operational 10/28/97
DSS 54	34-m S-/X-band beam waveguide antenna	Operational 9/29/97
DSS 61	34-m S-/X-band antenna	Decommission 12/1/98
DSS 63	70-m S-/X-band antenna	
DSS 65	34-m S-/X-band high-efficiency antenna	
DSS 66	26-m S-band antenna	

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<u>Section 920</u>
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Herndon, W. 605-133
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Mischel, D. GDSCC/07
Mitchell, C. 303-404
Nevarez, R. 507-120
Gillam, I. 502-400
Wackley, J. 303-404

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Lorenz, B. 532.0
Mack, W. 301.0
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Morse, G. 530.0
Sizemore, K. 407.0
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